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A CONSIDERATION OF THE RELATIVE MERITS OF RESECTION AND GASTRO-ENTEROSTOMY IN THE TREATMENT OF GASTRIC AND DUODENAL ULCER[1]

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THE question as to the relative merits of resection and gastro-enterostomy in the treatment of gastric and duodenal ulcers has not as yet been settled, as is evidenced by the papers presented at the recent medical and surgical congresses. The final decision as to which operation to perform lies with the surgeon, and to enable him to make such decision he must have practical experience involving a large number of cases observed over a period of several years. In order to learn the end-results in our clinic —a most important postulate—I have had our assistant surgeon, Dr. Wydler, study the ulcer cases which we have treated since 1910 (247 cases), and make repeated follow-up examinations of them. In this manner we hoped to help in solving certain diagnostic problems, in determining the general indications for operation, and finally in deciding upon the best technique to use in any particular case. Our own statistics differ from those of other operators in that we have made not only more frequent follow-up examinations of our cases but especially in that during the entire period of study we have done both gastro-enterostomies and resections so that we are in position to draw conclusions as to the results of the two operations. A complete report of the results of this study was published in the *Schweizerische medizinische Wochenschrift*, 1921, No. 25. In this paper, therefore, we shall present only the most important diagnostic points from the point of view of the practical surgeon and shall give the results of the different procedures as we find them.

INDICATIONS

We consider an operation indicated when stenosis or repeated bleeding is present and endangers the life of the patient or when persistent symptoms resist all efforts at medical treatment, and thus impair the efficiency and well-being of the patient. These limitations are mentioned because many ulcers heal spontaneously or with medical treatment, because in some cases, even after operation, the tendency to form ulcers still remains, because operation does not in all cases effect a cure, and because operation is accompanied by a certain risk and certain sequelæ may follow intervention, as for instance, ulcus pepticum jejuni.

Inasmuch as 70 per cent of the patients who come to us for treatment have suffered for from 5 to 30 years with gastric disturbances and a large proportion of the cases has been given systematic non-surgical treatment without improvement, we have

[1] Read before the Chicago Surgical Society, October, 1921

adopted certain fundamental principles in dealing with them.

DIAGNOSIS

The following points which it is especially important that the clinician should know are presented.

The rôle of the hydrochloric acid. Too much importance is attached to the rôle played by hydrochloric acid. In reality, in gastric or duodenal ulcers, the percentage of cases showing hyperacidity is far less than the percentage showing normal or subnormal acidity. According to our statistics there is a hyperacidity in about two-fifths of the cases with gastric ulcer and in one-third of the cases with duodenal ulcer. Hyperacidity is, indeed, more frequently present in ulcer cases than in carcinoma cases, but this fact must not be used as a sign arguing against the presence of carcinoma when other findings point to carcinoma. In cases in which carcinoma is suspected, one should not wait for a change in acid reaction before turning the patient over to the surgeon. Gluzinsky, Kocher, and Fonio attach great importance to the increase in hydrochloric acid produced with test meals containing protein as compared with the test breakfast. We have tried this in 73 cases of ulcer and have found that the methods agreed 42 times and disagreed 31 times (including one case of carcinoma). Even if it is a contra-indication to carcinoma of the stomach (increase of hydrochloric acid with test meal), still this is by no means true in all cases. There are variations from the rule in both directions—there may be an increase of hydrochloric acid in carcinoma cases and conversely there may be a decrease in hydrochloric acid in benign ulcer cases.

Lactic acid. It was not possible to detect lactic acid in any case of ulcer which was found benign at operation. It has long been known that the lactic acid test, when positive, is of much greater significance than the hydrochloric acid test.

Occult blood in stools. While we seldom fail to find occult blood in carcinoma cases with the guaiac and benzidine tests, after 3 days of meat-free diet and other precautions including avoiding brushing the teeth, the test was positive in only 50 per cent of the gastric ulcers and 65 per cent of the duodenal ulcers.

Roentgen examinations. We will discuss but briefly tonight the rôle played by roentgen-ray examination in diagnosing gastric and duodenal ulcers. A complete account of our own experience at the Basle Clinic will be found in Stierlin's book. However, I would like to state that in gastric ulcer we have found exact localization possible by roentgen examination in 87 per cent of the cases and impossible in 13 per cent. In 100 cases of ulcer of the lesser curvature 72 showed definite niches. Generally speaking, in half the ulcers of the lesser curvature, there was a six-hour retention showing spastic retention. In duodenal ulcer localization was possible with the roentgenogram in 54 per cent of the cases. Definite niches were found four times. It was possible to make a definite diagnosis of ulcer of the lesser curvature and of the pylorus in most cases, while in ulcer of the duodenum diagnosis was possible only through the process of elimination. As the study of the forms of bulbus duodeni becomes more and more exact so will the diagnosis become more positive in character.

Regarding the dentations on the greater curvature, Dr. Stoccada has shown, with the material from our clinic, that these are more frequent in gastric and duodenal ulcer cases than in carcinoma cases, but that they may occur in cases of gastric carcinoma and also in cases with anatomically sound stomachs.

PATHOLOGICAL STATISTICS OF ULCER

In 6 per cent of the cases a positive differentiation between benign ulcers and carcinoma could not be made at operation and the diagnosis was possible only after histological examination. Carcinomatous degeneration of an originally benign ulcer could be demonstrated with certainty in 1.4 per cent of the cases. This number should represent only a lower limit. Multiple ulcers occurred in 9.3 per cent of the cases.

IMMEDIATE RESULTS OF OPERATION

The operative mortality after gastroenterostomy in our series is 6.5 per cent, that

after radical operation 7.7 per cent. In addition there are two late deaths after gastro-enterostomy, one from renewed bleeding from the ulcer, the other from perforation of an ulcus pepticum jejuni. These concern the operative mortality only indirectly but must be considered in making comparison with the statistics for resection. The relatively high operative mortality after gastro-enterostomy is dependent upon the facts that the stringent rules we have adopted in selecting cases for operation exclude the mild cases of ulcer and that moderately severe cases are often operated upon by resection, so that gastro-enterostomy has been done in a great number of bad cases.

The most important causes of death—and really three-fourths of the true postoperative deaths are due to lung complications—are emboli, pneumonia, and lung gangrene. The danger of these complications depends more on the extent of operation than on the question of anæsthesia. Even after local anæsthesia we have seen embolic processes and pneumonia. Perhaps there will always be an opportunity here to improve our method of procedure. The statistics from our clinic confirm the old conception that a good share of cases which suffer, following operations upon the stomach, with so-called pneumonia are in reality suffering from a process embolic in nature. In three cases the causes of death were, respectively, bleeding from the existing ulcer, a simple heart failure, and the failure of the suture to hold in a Billroth I operation.

In two cases we had to deal with what was formerly so much feared—a vicious circle—and in both cases we were fortunate in securing favorable results. In two cases there was a hard infiltration in the omentum and in the connective tissue of the mesentery but no acute inflammation. The entire region of the operation was changed to a compact cake. The symptoms in this condition may simulate those of vicious circle.

Ulcus pepticum jejuni was observed eight times in our own cases and twelve times in cases of primary operation done elsewhere. We do not doubt that this condition will be found more commonly the more often and carefully the patients are examined. This complication very commonly follows the von Eiselsberg pylorus-exclusion operation. The suture material used is a big factor in producing peptic ulcer. This observation prompted us to avoid using non-absorbable suture material. After experimenting with different materials in animal research work, we have decided to use fine catgut in suturing the mucosa and serosa re-enforcing these continuous sutures with cotton stitches. The stitches serve at the same time to close the opening in the mesentery. Since adopting this method (1917) we have observed only one case of ulcus pepticum.

LATE RESULTS

Cases which on repeated examination remain completely free of symptoms, also those who present only insignificant symptoms, are entered as cured; those in whom there is no improvement at all or only slight improvement or in whom manifest symptoms still remain, are entered as unimproved.

Because of the danger of peptic ulcer following operation and because of repeated bleeding from the primary ulcer, we have abandoned schematic gastro-enterostomy and lean more toward resection. I would summarize my results in the following statements.

1. That 90 per cent of ulcer recurrences, peptic ulcer and other disturbances, occur in the first 4 years after operation, so that statistics which depend on results reported earlier than 4 years after operation are apt to show too favorable results. Observations made in the first 4 years after operation do not contain all the possible sequelæ, and therefore later observations must be made in order to secure the final results.

2. That simple gastro-enterostomy produces in all forms of gastric ulcer about the same early results—somewhat more than four-fifths cure or improvement approximating cure.

3. That observations made over longer periods and including all cases show for gastroenterostomy for all types of gastric ulcer, a cure or improvement in 75 per cent of cases. In ulcers at a distance from the pylorus the average results are no less favorable than in those at the pylorus.

4. That the radical methods, irrespective of interval, show results similar to those in gastro-enterostomy at early periods, with a cure in about 80 per cent.

Let us compare the results of the different methods of operation. The so-called sleeve operation, transverse section, whether carried out on the fundus or near the pylorus gives very satisfactory results. The V-shaped excision is unsatisfactory. The end-results of the Reichel-Pólya operation—end-to-side anastomosis of the stomach to the upper jejunal loop with blind closure of the duodenum—are yet to be reported. Its possibilities should not be overlooked. Chemical analysis made after most of the operations showed a decrease in acidity, most marked after the Reichel-Pólya operation, less marked but still present in the majority after sleeve operation, and in varying manner after gastro-enterostomy. This decrease is often permanent but in some cases the acid production slowly returns to normal, indeed to hyperacidity. This latter holds true at least for gastro-enterostomy. In X-ray pictures we found after gastro-enterostomy in 6 cases a complete and in 2 cases a partial disappearance of Haudek's niche. We point to this observation with all reserve for it must be studied further. The reflex pylorospasm of ulcers of the lesser curvature disappears with the sleeve operation but may appear later if a recurrent ulcer forms.

As a result of the findings as stated, we believe we are justified in making the following statements as regards the value of the different procedures.

Even if we consider the fact that the rules which we have laid down in selecting cases for operation are very strict and that we have in general not operated upon mild early cases of ulcer, still we do not doubt but that with an increase in the number of cases operated upon by sleeve resection, the immediate operative prognosis will become less favorable. The operation requires more time and affords greater opportunity for the production of emboli and thrombi than does gastro-enterostomy. This is compensated for somewhat by the fact that after resection, there is no late bleeding from the ulcer with the resultant occasional death, and the danger from peptic ulcer is almost nil. Also as resection is used more the technique will be perfected and the results will improve accordingly.

In gastric ulcer in all locations we find that about the same end-results follow gastro-enterostomy as the radical method. However, in this connection let us leave out of consideration the V-shaped excision which has proved a bad method not only in our hands but also in the hands of others, and consider only sleeve resection. With this method we find a cure in 90 per cent of the cases. This is a result not obtained with gastro-enterostomy, indeed, even if compared only with the more favorable statistics as derived from tabulations made early after operation.

Similarly with duodenal ulcer, gastro-enterostomy yields 65 per cent cures with or without the von Eiselsberg exclusion, while in 9 cases operated upon by resection we find all remain cured. If properly executed, resection yields better end-results than gastro-enterostomy whether in a case of gastric or duodenal ulcer.

In these facts there lies a satisfactory reason for employing resection even though it involves somewhat greater operative risk. At this point we should state that this is true only when we do not hold ourselves to a fixed rule but rather are governed by the conditions which confront us. Among such conditions may be mentioned the location of the ulcer and the resistance of the patient; also the conditions under which the operation is to be carried out, for there are conditions independent of the patient under which it is better that the surgeon does not resect, even if resection can be done. We include here among other things technical experience and the type of assistants present. It is pleasant to be able to determine by statistics that one can with good conscience decide not to resect if these external conditions are not satisfactory. Regardless of the type of ulcer, one can do the patient a greater service by performing a good gastro-enterostomy than by doing a resection under unfavorable circumstances.

BENIGN TUMORS OF THE STOMACH

Report of Twenty-Seven Cases[1]

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BENIGN new-growths of the stomach, which, because of their size or position, may cause disturbed gastric function are rare enough to be regarded as clinical curiosities. In fact the great preponderance of gastric cancers over benign tumors of the stomach largely explains why the latter receive scant consideration in the differential diagnosis of doubtful cases. A pre-operative diagnosis of benign gastric neoplasm is exceedingly difficult in the majority of cases, and has rarely been made at least until very recently. A great many of the cases reported in the literature have been found at necropsy and in the majority of those found at operation the true nature of the lesions had not been determined beforehand. In view of the importance of surgical conservation of such a useful organ as the stomach, the possibility that new-growth is benign takes on a very practical aspect. Of further clinical and diagnostic importance is the fact that these tumors may cause complications such as pyloric obstruction, intussusception of the stomach into the duodenum, recurring severe gastro-enteric hæmorrhage, strangulation, severe colic, malignant degeneration, and even perforation.

Two instructive reports on this subject have been presented before this association by the late Dr. Jesse Myer, and by Basch. For additional general reviews of the literature on the subject including excellent case reports and complete bibliographies, I would recommend the articles by Campbell, Merrill, Outland and Clendening. Reports concerning specific portions of this material already have been published by two of my colleagues, Balfour and Lemon, and by Nadeau and MacCarty in a pathological abstract.

The material, comprising 27 cases, all verified at operation, is composed of ten myomata, five fibromata, four angiomata, two dermoids, one gastric polyposis, two adenomata, and three polypis. Their histological subdivisions will appear in the more detailed consideration of each group. These cases fall easily and logically into clinical classifications, a primary and a secondary; in the former group it was the presence of the tumor itself which caused the symptoms justifying surgical interference, while in the latter it was an associated or accidental finding during the course of an operation for other obviously major disease. A brief résumé of the entire series appears in Table I.

The 27 patients in the series were under observation in the Mayo clinic between the years 1907 and 1921. During this period operation had been performed on 2,140 patients with cancer of the stomach, on 20 with sarcoma, and on 2 with malignant polyps of the stomach, a total of 2,168. The proportion, therefore, of malignant new-growths to benign new-growths is as 78 to 1, or 1.3 per cent of all gastric tumors were benign. But this proportion, in our experience, is only relative, for during the same period 2,285 additional cases of malignant gastric neoplasms, the majority of them inoperable, passed through the clinic.

Myomata. This group, of ten cases, has been histologically subdivided into three leiomyomata, three adenoleiomyomata, and four fibromyomata. The three leiomyomata were classified clinically, primary. Two of the patients (Cases 19940 and 206857) were men aged 66 and 44 respectively. Both had a marked myomatous hypertrophy involving more or less of the entire pyloric ring and presenting a palpable tumor, the first one 6 centimeters by 3 centimeters in size. Both patients had distressing gastric disturbances

[1]Presented before the American Gastro-Enterological Association, Boston, June, 1921.

TABLE I.—BENIGN TUMORS OF THE STOMACH

Case	Sex	Age	Lesion	A Location; B Size	Clinical Features
*10940	M	66	Leiomyoma	A. Two-thirds of pyloric ring B. 5 cm. by 7 cm.	Gastric disturbances, irregular type; indefinite colic pains; later ulcer type; palpable mass in epigastrium; hyperacidity, gastric retention
*14084	M	45	Leiomyoma	A. Antrum, near pylorus, cardia and œsophagus, jejunal B. 0.5 cm. to 2 cm.	Recurring melæna, occasional diarrhœa; dysphagia Anæmia; diagnosed asymptomatic bleeding ulcer Gastric analysis not made
*200857	M	40	Leiomyoma	A. Pyloric ring B. Well-marked muscle tumor	In many respects had a duodenal ulcer syndrome Hyperacidity and hypersecretion
891	M	62	Adenoleiomyoma	A. Greater curvature just above pylorus. B. 1.5 cm. in diameter	Large ulcer on the lesser curvature with crater
77451	F	60	Adenoleiomyoma	A. Anterior wall of greater curvature 5 cm. from pylorus B. 1 cm. by 2.5 cm.	Cholecystectomy; appendectomy
209071	F	28	Adenoleiomyoma	A. Lower anterior wall B. 1.5 cm. by 2 cm.	Gastric neurosis
*40886	M	48	Fibromyoma	A. Posterior wall B. 6 cm. by 8 cm.	Three-year-ulcer type of complaint; melæna High normal gastric acidity; obstruction; tumor
*142605	F	65	Fibromyoma	A. 7.5 cm. above pylorus; posterior middle wall B. 5 cm. by 7 cm.	Chronic painful epigastric complaint; achylia; secondary anæmia Movable, nodular tumor in left epigastrium. Intussusception tumor with posterior gastric wall into duodenum (Fig. 2)
*230057	F	35	Fibromyoma	A. Anterior wall 3.5 cm. above pylorus and close to greater curvature B. 2 cm. by 1 cm.	Gastric disturbances of 3 months' duration Severe attacks of pain. Tumor near pylorus "ball valve." X-ray: Filling defect in pylorus with large six-hour retention Normal acidity (Fig. 1)
334803	F	61	Fibromyoma	A. Anterior wall B. 2.5 cm. in diameter	Pelvic inflammation; chronic cholelithiasis Diabetes mellitus
*53373	F	40	Fibroma	A. Submucosa; pylorus B. 3.5 cm. by 2.5 cm.	Indefinite dyspepsia for 2 years, continuous for last 5 months. Discomfort one-half hour after meals; emesis gave relief; subacidity: mobile tumor
*86627	M	30	Fibroma	A. Pylorus B. 8 cm. by 5 cm	History similar to that of duodenal ulcer of 4 years' duration Hyperacidity; occult blood in fæces
*208743	F	16	Fibroma	A. Pylorus B. 3 cm. by 2.5 cm. by 2.5 cm.	Ulcer type of complaint and associated with duodenal ulcer; secondary anæmia. Palpable mass in the right epigastrium. Prepyloric filling defect (Fig. 3)
241305	F	51	Fibroma	A. Not stated B. Pedunculated; 7 mm. by 2 mm.	Duodenal ulcer
*313898	M	66	Fibroma	A. Anterior wall B. 1.5 cm	Associated carcinoma of cæcum; gastric history symptomless X-ray showed lesion at outlet; moderate 6-hour retention (Fig. 4)
*258233	M	67	Hæmangioma	A. Anterior wall; body of stomach B. 6 cm. by 5 cm. by 5 cm.	Complaint 6 months' duration; diarrhœa, melæna; 2 months' indefinite aching in left costal margin; 2 weeks' indefinite pain in the right costal margin; sense of fullness with discomfort; appetite good; weight loss 25 pounds; free hydrochloric acid (Figs. 5 and 6)
*324147	F	25	Hæmangioma	A. Midway on greater curvature B. 2.5 cm. by 2.5 cm. by 2 cm.	A typical history; hæmatemesis, melæna, and diarrhœa Anæmia; normal gastric chemism; ulcer crater in apex of tumor Lesions in posterior wall and greater curvature (Fig. 7)
*343572	M	50	Hæmangioma	A. Anterior wall—bologna shape B. 11 cm. by 3 cm. by 2.5 cm.	Dyspnœa, weakness, severe anæmia; no gross bleeding Occasional emesis and sense of fullness after meals Ulcer area 3 cm. by 5 cm. on tip of tumor (Figs. 8 and 9)
*356641	F	22	Hæmangioma	A. Duodenopyloric B. 7 cm. by 5 cm.	Dyspepsia since childhood, provoked by indiscretion; nausea and headache 2 to 3 hours after meals, sour emesis and relief; prevented by using soda before and after meals. Two acute attacks of epigastric pain 6 weeks prior to admission (Figs. 10 and 11)
*P10206	M	31	Dermoid	A. Posterior wall B. 7 cm. by 6 cm. by 5 cm.	Recurring hæmatemesis and melæna; weakness; anæmia (hæmoglobin 40 per cent); no dyspepsia; free hydrochloric acid present
*136147	M	8	Dermoid	A. Posterior wall B. 1,000 gm.	Upper abdominal tumor of gradual growth, 4 years' duration; increased markedly in size in last 6 months; urinary frequency (Figs. 12 and 13)
*250518	M	31	Polyposis	A. Entire lower two-thirds of stomach	Indigestion for 8 years; ulcer type of complaint continuous for past year; no nausea or vomiting; occasional diarrhœa; no hæmorrhage; loss of weight; achylia; mucus; characteristic X-ray findings (Figs. 14, 15, and 16)
237007	F	27	Adenoma (Brunnerian)	A. 1 cm. above pylorus B. 2.5 cm. by 1.5 cm.	Gall-bladder disease
2206	F	30	Adenoma	A. Lesser curvature 5 cm. above pylorus	Gastric neurosis; chronic appendicitis
80723	F	29	Polypus (adenoma)	A. Near the pylorus B. "Small"	Gastric resection for hypertrophy of the pylorus
220699	F	20	Polypus (multiple papillomata)	A. Throughout stomach and jejunum B. 5 mm. to 3 cm.	Duodenal ulcer; second operation later for resection of jejunum
343302	F	38	Polypus (adenoma)	A. Posterior wall 7 cm. to 10 cm. above pylorus B. 11 mm. by 8 mm.	Gall-bladder disease; migraine; anæmia; healed tuberculosis at both apices

*Primary cause for operation.

Fig. 1

Fig. 2

Fig. 3

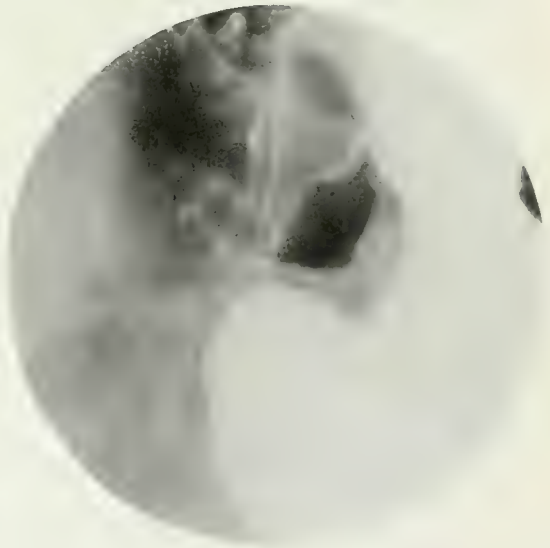

Fig. 4

Fig. 1. Filling defect in the pylorus with a large 6-hour retention. Small fibromyoma on the interior wall above the pylorus, close to the greater curvature.

Fig. 2. Unusual filling defect. Intussusception of the tumor with the posterior gastric wall into the duodenum.

Fig. 3. Prepyloric filling defect. Fibroma at the pylorus. Six-hour barium retention.

Fig. 4. Lesion at the outlet; moderate 6-hour retention. Small fibroma of the anterior wall and pylorus.

over a long period in many respects simulating chronic ulcer. Hyperacidity and gross retention were present in the gastric contents of the former, and hyperacidity and hypersecretion in the latter. The third patient (Case 44684) was a male, aged 45, with symptoms extending over a period of 5 years

The tumors were mural and multiple in the jejunum and œsophagus ranging in size from 0.5 centimeter to 2 centimeters, with one of medium size in the pyloric antrum. This case was characterized by recurring melæna, occasional diarrhœa, dysphagia, and anæmia, but an entire absence of dyspepsia.

The three adenoleiomyomata ranged in size from 1 centimeter to 2 centimeters, two were juxtapyloric on the greater curvature, the third on the anterior wall in the first portion of the antrum. Two were found during the course of an operation for ulcer or gall-bladder disease.

The four fibromyomata are of considerable clinical importance since three of them were primary, the patient seeking relief from them. The first patient was a man aged 48, with a movable tumor above and to the right of the navel. His dyspepsia was of 3 years' duration, strongly simulating ulcer. Gastric analysis revealed moderate hyperacidity and food retention. At operation a fibromyoma 7 centimeters in diameter on the posterior wall, was removed. The second patient, a woman aged 35, had had gastric complaint of 3 months' duration. The pain was usually severe. Gastric analysis and physical examination revealed normal conditions, but a filling defect of the pylorus, and a large barium residue was evident in the roentgenogram (Fig. 1). At operation a small tumor 2 centimeters by 1 centimeter was found on the anterior wall 4 centimeters above the pylorus, close to the greater curvature. While the tumor was not pedunculated it could be manipulated as a ball-valve, which probably explains the course of the painful seizures. The case of the third patient, a woman aged 65, is one of the most interesting in the series. She had had distressing dyspepsia for 6 years, progressive in character, with intermittent periods of food retention provoking emesis, and a palpable, movable, slowly growing mass in the left epigastrium of 4 years' duration. She had lost more than 60 pounds in weight during the 2 years preceding her examination. For 6 weeks immediately prior to her admittance, the patient had daily complained of irregular pains, of watery regurgitation and distress throughout the lower chest when swallowing and when regurgitating. Achylia and mucus were found on repeated gastric analysis, and a very unusual filling defect was revealed by the roentgenogram (Fig. 2). She had secondary anæmia. At operation (C. H. Mayo) a fibromyoma 5 centimeters in diameter was found on the posterior middle wall of the stomach 7.5 centimeters above the pylorus. The tumor, dragging with it the posterior wall of the stomach, had invaginated through the pylorus into the duodenum, a total distance of 12.5 centimeters, forming an intussusception of a portion of the stomach into the duodenum. Wade and Collier have reported similar complications in benign new-growths. In addition to these the museum contains three specimens of fair-sized myomata which have undergone sarcomatous degeneration.

Fibromata. The five tumors in this group occurred in patients ranging in age from 16 to 66. In one case, that of a small pedunculated fibroma, 7 millimeters by 2 millimeters, associated with a duodenal ulcer, the surgical records did not state the location, but the location in the remainder which were sessile, was definitely pyloric. According to the literature, this situation is the rule, although our specimens neither showed malignant changes nor represented fibrous growths at the site of old ulcers. Tumors varied in size from that of the smallest, already mentioned, to a diameter of 2.5 centimeters. Because of the position of the growth the roentgenogram revealed a filling defect in the pylorus and six-hour barium retentions (Figs. 3 and 4, Cases 208743 and 313898). In one patient (Case 53373), a woman aged 40, symptoms of 2 years' standing, continuous and progressively more marked for the last 5 months, in conjunction with anacidity, retained food masses, palpable tumor, and a pyloric filling defect, certainly justified the diagnosis of gastric cancer. In the second case a fibroma, measuring 8 centimeters by 5 millimeters which involved the pyloric ring, presented a syndrome characteristic of duodenal ulcer of 4 years' standing with hyperacidity. A pylorectomy in this instance resulted in complete cure.

Angiomata. The four tumors of this group are histologically hæmangiomata. They are exceedingly interesting because of their size and rarity. Lemon reported the first one of the series in 1920 and up to that time only five others had been reported in the literature. Two of our patients, both women, were in the second decade of life, one in the fifth, and one

Fig. 5

Fig. 6

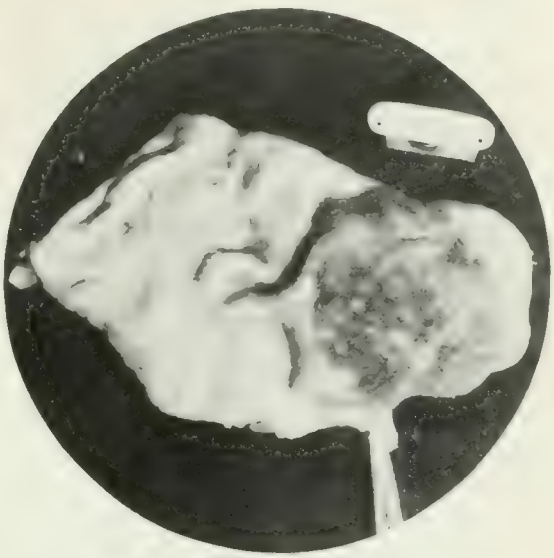

Fig. 7

Fig. 8

Fig. 5. Large filling defect of the pars media and the anterior wall. Angioma of the stomach (6 by 5 by 5 centimeters).

Fig. 6. Angioma of the stomach as it presented on the mucous surface.

Fig. 7. Filling defect on the posterior wall and greater curvature. Angioma on the greater curvature (2.5 by 2.5 by 2 centimeters).

Fig. 8. Roentgenogram of tumor of the anterior wall of the stomach.

in the sixth decade. With one exception free hydrochloric acid was present in normal amount, and motility in all was unimpaired. With one exception the tumors were round, sessile, quite mobile at operation, of fair size, but not palpable on abdominal examination. They lay between the mucosa and serosa, were of soft consistency, and bluish black, or red; the one heretofore reported, situated in the fundus and anterior wall, suggested on palpation a mass of angle worms and the cut section resembled lung tissue (Figs. 5 and 6). In the second case the rounded pedunculated growth 2.5 centimeters by 2.5 centimeters by

Fig. 9. Sausage-shaped tumor (11 by 3 by 2.5 centimeters).

2 centimeters, was attached midway to the greater curvature and posterior wall (Fig. 7). The ulcer crater in the apex of the tumor explained the bleeding and anæmia. In the third instance an unusual bologna-shaped tumor, measuring 11 centimeters by 3 centimeters by 2.5 centimeters, situated in the anterior wall was found. Dyspnœa and weakness were the complaints presented, but on closer questioning an occasional sense of fullness after meals and emesis were revealed. The patient, a man aged 50, was very anæmic (hæmoglobin 44 per cent), gastric analysis showed an absence of free hydrochloric acid, a considerable number of fresh red blood cells and bits of tissue in the lower power field. These features, with the filling defect in the roentgenograms (Figs. 8 and 9), strongly suggested cancer, and this was made the provisional clinical diagnosis. The fæces contained besides the blood, pathogenic amœba and flagellatæ. The latter had probably provoked the diarrhœa. Erosion was found in the tip of the growth.[1] The last case, the only one of its kind to my knowledge, illustrates the diagnostic value of routine roentgen-ray examination in all doubtful or obscure cases. The patient, a woman aged 22, was of a nervous temperament, and had had dyspepsia since childhood, which was characterized by nausea and marked frontal headache, occasionally extending to the occiput, usually appearing 2 or 3 hours after a meal, and terminating in an hour or two by vomiting of sour gastric contents, followed by complete relief. These attacks were brief and intermittent, were often provoked by dietetic indiscretions, and in later years were prevented by small amounts of soda before and after meals. Up to within 6 weeks before her examination epigastric distress or pain had been absent, but since that time she had experienced two violent attacks of pain in the epigastrium about 4 hours after a meal, preceded by the usual dyspeptic symptoms and terminating in emesis with relief. The patient attributed these seizures to excitement of moving in the first instance, and in the second to the hasty preparation for a trip. The physical examination was practically negative, except for moderate anæmia, which was attributed to a severe menorrhagia present since the onset of menstruation at 14. She was 12 pounds below normal weight. Gastric analysis revealed normal acid values with hypersecretion. The roentgenogram revealed a large rounded, mobile mass in a dilated duodenum, which was diagnosed benign tumor (Figs. 10 and 11). At operation (E. S. Judd) a rounded sessile mass just without the pyloric ring about 7 centimeters by 5 centimeters, covered by a thin mucosa, was easily removed. It had the gross appearance and feel of œdematous myoma, but on section and microscopic examination it proved to be a hæmangioma. The patient is having

[1] A detailed description of the above four cases of hæmangioma will appear in a paper by Dr. Judd.

an uneventful convalescence. The painful seizures can best be explained by a temporary occlusion of the pylorus by the tumor.

Dermoids. So far as I know only a few of these cases have been reported. Our first patient, a man aged 31, was one of the earliest cases in the clinic. For 4 years he had had recurring attacks of hæmatemesis and melæna, finally causing severe anæmia and weakness. Free hydrochloric acid was present (hæmoglobin 40 per cent). A tentative diagnosis of asymptomatic, bleeding peptic ulcer was made. Operation revealed a rounded tumor of the posterior wall of the stomach 7 centimeters by 6 centimeters by 5 centimeters. This was diagnosed dermoid by the pathologist. The second patient was a boy aged 8. About 4 years previously his parents had noticed a small lump in his abdomen, which seemed to be more prominent at times, especially when standing. The lump had enlarged gradually, but during the 6 months prior to examination growth had been marked. Aside from some urinary frequency the patient had no symptoms. Examination showed a large movable non-sensitive mass filling the upper and central portion of the abdomen. A gastric analysis was not made. Roentgenograms did not reveal retention

Fig. 10. Large, rounded, mobile mass in a dilated duodenum.

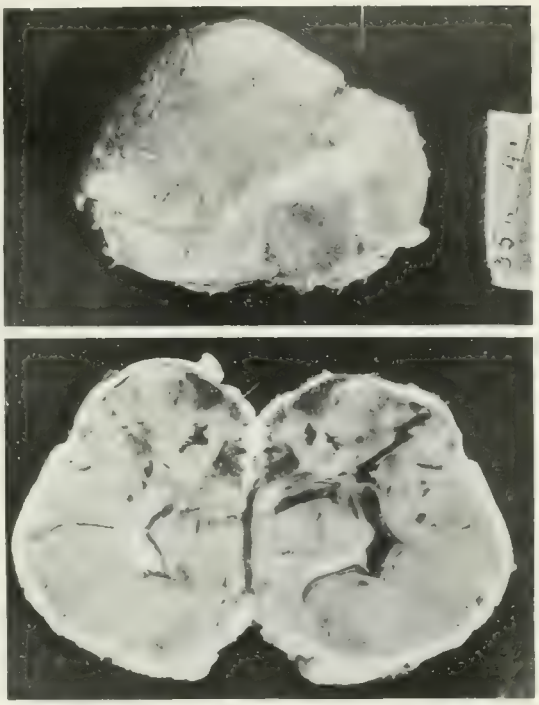

Fig. 11. Photograph of angioma 7 by 5 centimeters removed from duodenum proximal to the pyloric sphincter.

from the six-hour barium meal. The stomach was very high, occupying a transverse position. The displacement upward was due to a large palpable tumor which was extrinsic and did not deform the gastric lumen (Fig. 12). At operation a gourd-shaped tumor, weighing 1,000 grams, was found attached to the posterior wall of the stomach and projecting into the lesser peritoneal cavity. The tumor was larger than the stomach itself. This was diagnosed dermoid cyst by the pathologist (Fig. 13).

Gastric polyposis. This is probably the rarest form of benign tumor of the stomach. The only case seen in the clinic has been described in detail by Balfour. He states that the tumor was then found for the first time out of approximately 69,000 abdominal operations, 8,000 of which were for gastric lesions. Carman has seen only two cases in about 50,000 roentgen-ray examinations of the stomach, one of which was the one described by Balfour; the other was the case of polyposis reported by Myer. As a result of Myer's own careful clinical observations over

Fig. 12. Stomach displaced upward, occupying a transverse position.

a long period in this case, and of similar observations made in the cases of Wegele and Chosrojeff, he states that gastric polyposis is more than probably present when such a combination of acute gastric hæmorrhage, achylia gastrica, increased gastric motility, and abnormal mucus production of an egg-white character is observed. Achylia gastrica, hypermotility, and excess of mucus were present in our case, that of a man aged 31, with distressing epigastric symptoms of 8 years' duration. The roentgenograms in both cases are quite characteristic and show a diffuse mottled appearance of the pars pylorica and the lower pars media without 6-hour retention or a corresponding palpable mass. This mottling is due to the displacement of the barium by the approximation of the polypi which, offering no resistance to the X-ray, produce numerous small, black shadows in the silhouette of the stomach (Figs. 14, 15, and 16). Ruggles has recently reported one case with detailed roentgenological findings. This tumor was described as a

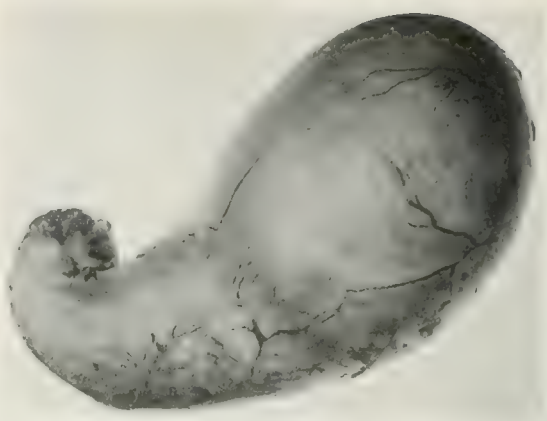

Fig. 13. Dermoid cyst (weight 1,000 grams) of the posterior wall of the stomach in a boy aged 8.

papillomatous rather than an adenomatous structure, as originally described by Menetrier. Finney and Friedenwald reported two cases of gastric polyposis which had undergone malignant degeneration.

Adenomata. There were two of these tumors in the series, both were small and in women aged 27 and 30 respectively. The first tumor, 2.5 centimeters by 1 centimeter, was situated 1 centimeter above the pylorus and was a Brunnerian adenoma, first described by Hayem. It was mural, apparently symptomless and was excised during the course of an operation for gall-bladder disease. The second one, found during the course of an exploratory operation, was also symptomless, and was a small, hard inflammatory adenoma, 5 centimeters above the pylorus on the lesser curvature. Novak and Stretton have recently reported single pedunculated adenomata on the posterior wall of the stomach, near the pylorus, in adults, causing symptoms simulating those of gall-stone colic. The literature dealing with the various types of gastric adenomata has become fairly extensive.

Polypi. The term polyp in the clinical or descriptive sense signifies any small pedunculated tumor. The majority of polyps are undoubtedly mucous. We have restricted the use of the term to adenomatous or papillomatous growths in conformity with pathological terminology. There were three of these in the series. All the patients were

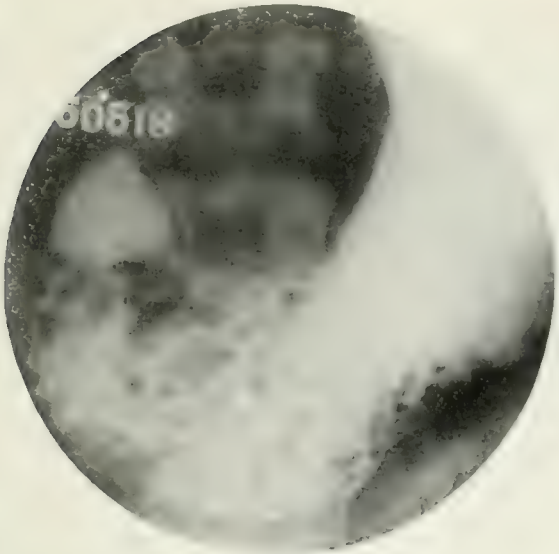

Fig. 14 Roentgenogram of gastric polyposis.

Fig. 15. Appearance in the roentgenogram of the stomach after Pólya resection.

women. The tumors had been found during operation for other major conditions. Two of the polyps were adenomatous, both single, one small, near the pylorus, the other 11 millimeters by 8 millimeters on the posterior wall, 7.5 centimeters to 10 centimeters above the pylorus. In a third case, that of a woman aged 38, the polypi comprised multiple papillomata, scattered throughout the stomach and jejunum, and varied in size from 5 millimeters to 3 centimeters. This patient had a chronic duodenal ulcer.

SUMMARY AND CONCLUSIONS

The 27 cases of benign tumors verified at operation, comprise seven different varieties in which are included myomata, with their histological subdivisions, fibromata, hæmangiomata, dermoids, polypi, adenomata, etc. They represent 1.3 per cent of all the gastric tumors which have been operated on. Seventeen of the entire number were clinically classified primary growths because they were found to be the chief cause of the patients' complaint. Perhaps the most interesting group in this series, because of comparative rarity and size, is that of the hæmangiomata. Twelve of the patients with this condition were males and 15 were females. The ages varied from that of a boy of 8 with a 1000 gram dermoid on the posterior wall of the stomach, to that of a man of 67 with a hæmangioma on the anterior wall and body of the stomach. The largest number, seven in each, was found in the second and sixth decades of life. One-half of all the patients were more than 40. In 13 cases the tumors were in close proximity to the pylorus, in 5 they occupied the posterior wall, in 5 the anterior wall, and in 2 they were generally distributed throughout the stomach. In one case in which the œsophagus and jejunum were involved, and in one, an early case, the records do not state the exact location. The size and shape of the tumor were variable because of the various types encountered. The majority were sessile rather than pedunculated. Gastric analysis and symptomatology afforded little aid in the diagnosis. Practically all the smaller tumors were symptomless. Seven patients had palpable tumors, 3 of which were fibromyomata, 3 were fibromata, 1 was a dermoid, and 1 was a leiomyoma. The average loss of weight in the primary group was 25 pounds. Ten patients had recurring hæmorrhage with anæmia and weakness. This was chiefly due to ulceration or erosion of a portion of the tumor. Three of the 4

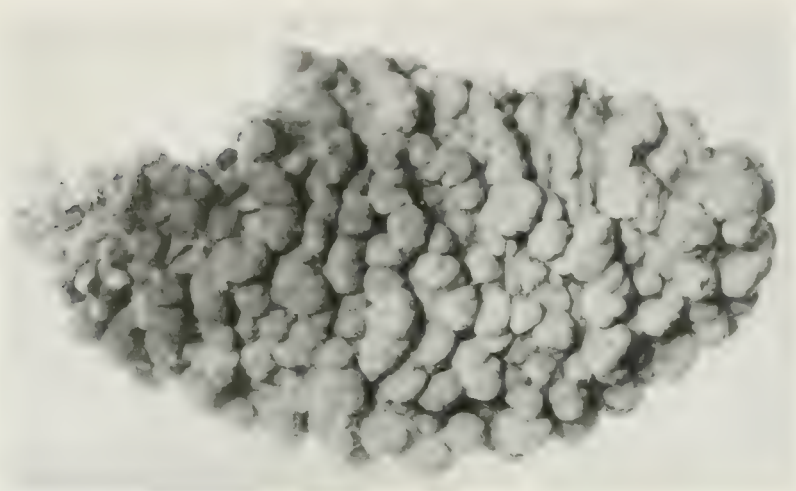

Fig. 16. Gross specimen showing gastric mucosa studded with polyps.

patients with angioma had severe bleeding and anæmia. Seven patients had obstruction; this includes one patient with a fibromyoma of the posterior wall which had caused an intussusception of the posterior wall of the stomach into the duodenum. Severe, painful seizures simulating gall-stone colic were noted in several cases of juxtapyloric tumors which even though not pedunculated could be manipulated as ball-valve tumors. Myomatous tumors of the pylorus, with or without pyloric obstruction, simulate the duodenal ulcer syndrome. The roentgenologic appearance of the larger tumors is quite indistinguishable from that of gastric cancer. Carman believes that a larger experience with this group will enable him to differentiate roentgenologically the two types more frequently than has been possible heretofore.

1. Benign tumors of the stomach are rare and constitute only 1.3 per cent of all gastric tumors that have come to operation. The actual proportion of benign new-growths to malignant new-growths or ulcerations is as 1 is to 200.

2. Myomata and fibromata constitute the largest group, gastric polyposis the most infrequent.

3. About 50 per cent of benign tumors are found in patients more than 40. There is no characteristic syndrome and gastric chemism ranges from achylia to hyperacidity with hypersecretion. The summation of evidence favors the diagnosis of gastric cancer.

4. The majority of the tumors are situated in the region of the pylorus, the greater curvature, anterior and posterior walls.

5. The smaller tumors are practically symptomless unless situated at the orifices or unless multiple.

6. Common complications are recurring hæmorrhage, which occurred in 37 per cent. and pyloric obstruction which occurred in 25 per cent. Palpable mass, food retention, or 6-hour barium retention is less frequent than in gastric cancer.

7. Often patients with benign gastric tumors are refused operation because the condition is regarded as malignant and inoperable. The true nature of the lesion is discovered only when the patients insist on operation.

8. The surgical end-results are excellent.

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INTERSTITIAL PREGNANCY

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DESPITE the relatively large number of interstitial pregnancies observed and operated upon in different clinics, the characteristic signs of this anomaly of gestation have not so far been described sufficiently clearly to enable one to differentiate in clinic this variety of extra-uterine pregnancy from any other variety. Its variable development and the symptoms peculiar to each case render clinical diagnosis almost impossible. Even the macroscopic anatomy of the specimens studied in many cases is open to discussion and presents obscure points. Waegeli (1) makes special mention of this in his review which includes the majority of cases reported up to 1915—more than 50 undisputed cases. Vaudescal emphasizes the importance of microscopic examination saying that in many cases histological study has not been made and that in many of the cases a diagnosis of interstitial pregnancy is questionable. According to Vaudescal microscopic examination is the only absolute means of confirming the presence of an interstitial pregnancy.

By reporting new cases, and by studying each case carefully, we shall certainly some day be able to recognize the signs and symptoms which will enable us to make a clinical diagnosis. We have had occasion to operate upon two cases of interstitial pregnancy, and we report below the findings in them.

Case 1. Left-sided unruptured interstitial pregnancy. Abdominal supravaginal hysterectomy with ablation of the adnexa.

Anne Ch., age 26, entered Hospital Celtza, July 11, 1919 (No. 495). The family history revealed nothing of importance. The periods began when the patient was 13 and have always been irregular and associated with dysmenorrhœa. The patient has been pregnant seven times; four pregnancies terminating in normal labor and puerperium, three in abortion at about 6 weeks, without complications. The patient claims never to have been ill.

Present illness. The last menstrual period began March 25, 1919. About 2 weeks following the time for the appearance of next period, the patient was taken with severe pelvic pains and a sudden hæmorrhage which was followed by the expulsion of a white membrane. The bleeding with expulsion of the membrane was ascribed by the patient to an abortion. Since this time (about 2 months ago) there has been irregular loss of blood, extending over periods of 1 to 3 days, and repeated approximately every 8 days. Because of this bleeding, the patient decided to enter the hospital. Aside from the metrorrhagia there was no complaint of other functional phenomena, neither pain nor leucorrhœal discharge. The general health of the patient was good, there was no elevation of temperature. Examination of the principal viscera and systems failed to reveal any appreciable pathology. The breasts showed neither lacteal secretion nor areolar changes.

No tumefaction was found in the pelvic cavity by abdominal exploration. The cervix was hard and turned to the left. The external orifice was transverse with a laceration to the left. With the speculum, an ectropion of the anterior lip of the cervix could be observed. The body of the uterus was displaced to the right, it was increased in size, in anteflexion with a slight lateroflexion. The fundus was normal on the right. On the left could be felt a rounded sessile tumefaction the size of an egg and incorporated with the uterine cornu, without an appreciable demarcing depression and movable *en bloc* with the fundus. The tumor was smooth and

Fig. 1. Cross section of specimen shown in Figure 2, viewed anteriorly.

Fig. 2. Anterior view of left-sided, non-ruptured, interstitial pregnancy, Case 1. The enlarged uterus is composed of two masses; on the right the uterus is of practically normal dimensions, on the left the ovular tumor the size of a large walnut is separated from the uterus by a slight depression. The thickened left round ligament is attached on the anteroposterior aspect of the gestation mass. The left tube, normal in appearance and length (8 centimeters) is attached on the left border of the tumor a trifle lower than on the opposite side. The right tube is somewhat distended and measures 7.5 centimeters. The left ovary is normal and contains a corpus luteum on its superior border. The right ovary, double in size and infiltrated with microcysts, is covered with dense adhesions.

Fig. 3. Anterior view of right ruptured interstitial pregnancy, Case 2. The uterus is normal on the left. At the level of the right horn is a rounded mass, separated from the corresponding border by a scarcely perceptible depression. As a whole the extirpated mass is asymmetric, the right horn forming the apex of a cone. The right round ligament inserts on the antero-inferior aspect of the cornual tumor, a trifle higher than that of the opposite side. The two tubes are apparently normal and are of the usual length.

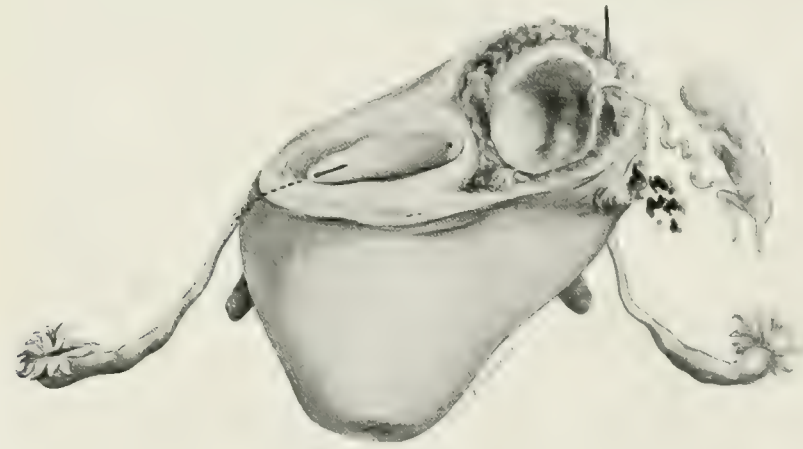

Fig. 4.

Fig. 4. Cross section of specimen, Case 2. A stylet in the left ostium uterinum is shown penetrating the lumen of the isthmic portion of the corresponding tube. The right ostium uterinum leads into the intramural sac. A stylet indicates the position where the tubal isthmus opens into the ovular sac. The ovular sac is formed of a thin muscular wall, containing an intact ovum, covered by placental tissue. An embryo of 10 centimeters is suspended by a delicate umbilical cord from the ovular sac.

a trifle softer in consistency than the uterus. The vaginal fornices were free on the left side both front and back. On the right side could be palpated a swelling which was painful. The swelling was the size of an almond and resembled a right-sided chronic adnexitis.

Operation, July 20, 1919. Lumbar and spinal anæsthesia—0.72 centigrams of novocaine. Medial subumbilical laparotomy. Upon opening the abdomen, the lesions found confirmed the clinical diagnosis: on the left a rounded tumor, on the right the ordinary adnexal lesions. We therefore did a supravaginal, abdominal hysterectomy with extirpation of the adnexa on both sides, peritonization, and closed the abdomen without drainage. The postoperative convalescence was without incident, the patient was up and about on the eighth day and left the hospital in good health on the twentieth.

Examination of the specimen. The specimen secured was composed of the uterine corpus and the adnexa (Fig. 2). From in front the uterine body is of irregular form, and is enlarged toward the fundus to almost double its normal size. It appears to be composed of two masses: that on the right, of a mass normal in outline and of the dimensions of the body of the uterus; that on the left, of a rounded mass situated on the border of the uterus at the level of the corresponding horn and not extending above the level of the fundus. Smooth, rounded, the size of an unhulled walnut and of a trifle softer consistency than the fundus, this mass is distinguishable from the corresponding uterine border by a very shallow, vertical depression more marked upon the anterior face and giving to the whole a bi-lobed appearance. The entire surface of the uterine mass is covered by smooth peritoneum without adhesions.

The transverse diameter of the whole at the level of the tubes is 8 centimeters, the height of the corpus is 5½ centimeters. Viewed posteriorly, the specimen presents the same general aspect except that here the tumor seems more evidently bulging especially vertically as a whole.

The left round ligament is attached to the antero-inferior face of the left uterine mass, at a distance of ½ centimeter from the left tubal attachment. It is a trifle larger than the opposite ligament, having a diameter of 1 centimeter. The right round ligament is attached to the corresponding uterine horn, 5 millimeters below the tube.

The left tube, normal in appearance, is attached to the left side of the uterus, on the antero-external border of the corunal tumor, somewhat lower down than the opposite tube is attached. It is of normal length, measuring 8 centimeters and is permeable.

The right tube, somewhat distended and nodular, is 7½ centimeters long and is surrounded by a few adhesions. The infundibulum is permeable; it is attached at the extremity of the corresponding uterine horn.

Cross section along the uterine fundus for the purpose of studying the interior aspect of the cornual tumor (Fig. 1) shows the presence of an abnormally placed gestation. This section shows the uterine cavity increased in volume in the transverse diameter and asymetric. The left half of the fundus is farther developed than the right and forms a sort of diverticulum, directed upward and laterally. The cavity of the uterus therefore is shaped like an unequal T. The walls of the uterus are hypertrophied; their thickness varying from 8 to 10 millimeters, but beginning progressively to attenuate toward the left horn of the fundus uteri. In the left uterine horn, entirely within the muscular wall is seen an intramural cavity containing a fœtal cyst. The ovum is about 3 centimeters in diameter, or about the size of a small walnut. It consists of an amniotic sac, completely filled with a transparent, pale yellow liquid, which surrounds an embryo of 1.5 centimeters. The small size of the embryo as compared to the duration of the gestation, suggests that the ovum has been arrested in development. Between the ovular membranes and the left wall of the ovular attachment is a deposit of clotted blood. To the right the fœtal cyst over half its external surface is covered by placental tissue. The placenta, adherent to the uterine muscle, can be separated from it by a spatula. The intramural ovular cavity is limited by a layer of muscular tissue of 1 to 3 millimeters in thickness. On removing the fœtal cyst it is found that the ovular cavity communicates freely on the side with the interior of the tubal isthmus. A stylet introduced into the fimbriated extremity of the tube passes backward into the ovular cavity. The left uterine horn communicates by way of the dilated ostium uterinum, through an intermediary canal of about 7 to 8 millimeters in length, opening into the intramural. A partition of 1 to 2 millimeters thickness, easily seen in Figure 1, separates the left uterine horn from the ovular cavity. The mucosa of this horn appears to be interrupted at the level of the canal of communication between the two cavities: uterine and ovular. On the right a fine stylet may be introduced into the natural opening between the uterine horn and the tube (ostium uterinum), visible to the naked eye.

To summarize, we have in this case a para-VII, 26 years of age who, following a delay of menstruation of 15 days, suffered with pelvic pains and metrorrhagia and expelled a membrane, the condition being ascribed to an abortion. Following this painful crisis, the metrorrhagia in scant amount continued for approximately 2 months, for which reason the patient decided to enter the hospital. Because of the history and because of the presence of a tumor at the level of the left uterine horn, we considered the possibility of a fibroid. Laparotomy disclosed a pregnancy abnormally placed in the left uterine wall.

Macroscopic examination showed the ovular cavity entirely within the muscular wall, the round ligament attached below the fœtal tumor, of the normal length of the corresponding tube, all of which findings suggest the anatomical diagnosis of inter-

stitial pregnancy. Unfortunately the disorganization of our laboratories following the war has not permitted us to make a histological study of the specimen.

Case 2. Ruptured interstitial pregnancy. Supravaginal abdominal hysterectomy with conservation of both ovaries.

Lucrece, J., age 42, entered the Maison de Sante of Dr. Antonin, July 3, 1920, to be placed under observation following curettage in another city. Patient had eight brothers and sisters, of whom two are in good health and two are dead, having succumbed to typhoid. Menstruation began at 12, and the periods have been regular, abundant, lasting 7 to 8 days, and have been preceded and followed by pain. Patient was married at age of 17, and is now a para-VII. She was pregnant the first time 6 months after her marriage. Labor was normal and a living child was delivered. The second pregnancy, 4 years later, was followed again by the birth of a living child. The third pregnancy, some months after the preceding, resulted in the birth of a dead fœtus. A fourth pregnancy, 3 years later, resulted in a living child, which died later of meningeal complications. The fifth pregnancy terminated in an induced abortion at 4 weeks which resulted in pelvic infection lasting 4 weeks and necessitating the opening of an abscess in the iliac fossa. Impregnation occured a sixth time, 6 months after this abortion, and at term a living infant was delivered. Since this sixth pregnancy the patient has been well. Periods have been regular and without pain. Among preceding pathological conditions is mentioned the fact that at the age of 23, the patient suffered from blenorrhagia, this occurring between the second and third pregnancies. The husband was afflicted with syphilis at the time of marriage.

Present illness. The last normal menstrual period occurred April 29 to May 4, 1920. The following period, May 29, 1920, was missed. After 15 days, toward the 13th of June, the patient aborted following curettage by a physician. After this she states that she felt well for about 8 days. Nine days after abortion she was taken with chills and she noted a serous vaginal discharge. Because of persistent nausea and the absence of bleeding, the physician decided to do a second curettage (June 28, 15 days after the first). Following this, there were pelvic pains, localized in the left iliac fossa and the patient came for consultation to Bucarest.

Examination upon arrival. On July 13, 1920, 2 months after the termination of the last period, we found that the patient was suffering some mild pelvic pains, more marked in the right iliac fossa, which became more severe during the following days. There was a scant serosanguinous discharge, without any real bleeding. To these phenomena might be added, constipation, anorexia, and some headache. The temperature remained below 37° for a week, then rose to between 37° and 38° during the following 6 days. Vaginal examination disclosed a long, hard, gaping cervix, an enlarged corpus having almost the dimensions of a 3 to 4 weeks' pregnancy, soft, mobile, and flattened anterolatterally. The uterine cavity measured 8 centimeters, by hysterometry. The left adnexa appeared normal. On the right was found a swelling, the size of a fist, including the uterine border. At first we considered this mass a postabortive right adnexitis.

The patient was placed at rest. She was given vaginal douches and iodine was applied to the uterine cavity. On re-examining the patient, July 10, after 7 days of medical treatment I was surprised to find the uterus enlarged in size, its cavity now measuring 9 centimeters. The organ had developed more markedly toward the right horn. This condition suggested the possibility, despite the two successive curettages, of the presence of an abnormal pregnancy. Upon questioning the physician who had performed the two curettages I was told that he had both times secured what seemed to be ovular fragments. July 10, 9 weeks after the last period and about 1 month after the first curettage, the patient while coming from the dressing room was seized with severe abdominal pains, became pale and fainted, suggesting at once a rupture of an abnormal gestation. The patient was returned to bed, ice was applied to the abdomen, and the subsequent condition closely observed. Temperature 37.8° C., pulse 90. An examination on the following day disclosed a peritoneal inundation of moderate extent, rising to the umbilicus. Clots could be felt in the cul-de-sac of Douglas.

Operation. July 17, 1921, almost 10 weeks after the termination of the last period, the patient was submitted, under spinal anæsthesia, to a median, subumbilical laparotomy. Upon opening the peritoneum there was found extravasated into the peritoneal cavity a large quantity of coagulated and liquid blood. The uterus, increased in volume and asymmetric, presented on its right horn an elongated sessile tumor, the size of an egg, incorporated with it, the whole forming a mass conical in shape. In the posterolateral surface of the cornual tumor was a crateriform perforation, from which blood and clots passed and by which the interior of the sac communicated with the peritoneal cavity. The adnexa of both sides were normal. Supravaginal abdominal hysterectomy was done. Both ovaries were left. Suprapubic peritoneal drainage was established, and the abdominal wall closed with three layers of sutures. Postoperative recovery was excellent, the patient quitting the bed on the tenth day and leaving the hospital on the twelfth day, postoperative.

Examination of the specimen. The specimen from this case consists of the uterus and the two tubes, the two ovaries having been left *in situ* (Fig. 3).

The uterus, increased in size, forms an asymmetric body, ovoid, elongated toward the right horn, and forming an apex, and is occupied by a sessile tumor the size of a large hen's egg. A scarcely perceptible depression distinguishes the right uterine border

from the cornual tumor. The asymmetry is caused by the exaggerated development of the right uterine horn. On the posterolateral surface of the tumor there is an irregular defect, of about 8 to 10 millimeters in diameter. The elevated, smooth, violaceous mass is entirely surrounded by smooth peritoneum, free of adhesions. The vertical diameter of the uterus is 9 centimeters. The axis of the cone formed by the total extirpated mass measures 12 centimeters. The transverse diameter from one tubal insertion to the other is 8½ centimeters. Cross section through the fundus of the uterus toward the posterior aspect, including the superior border of the uterine tumor, discloses the existence of an interstitial gestation (Fig. 4). As can be seen in Figure 4, there are two independent cavities: (*a*) that of the enlarged uterus, and (*b*) that of the ovular sac, hollowed out in the left cornual wall. The cavity of the uterine fundus is increased in size, its two horns are moderately dilated; the right cornu forms a diverticulum directed above and laterally. The thickened uterine wall measures approximately 1½ centimeters. The uterine mucosa is congested. The uterine cavity is separated from the ovular sac by a muscular partition, of the thickness of about 3 to 4 millimeters. One may recognize with the naked eye in the walls of the two horns the tubal orifices (ostia uterina) which were successfully catheterized, by the aid of a fine metallic hairpin. A pin will pass from the uterine cavity into the left tube as may be observed in Figure 4. A fine stylet can be passed from the cavity of the fundus into the ovular sac on the right. The interior of the right uterine horn is a rounded, rather smooth cavity, having an encrusted appearance, and with a diameter of from 5 to 5½ centimeters. Its wall consists of a layer of muscular tissue 3 to 4 millimeters thick, and entirely covered by peritoneum save at the level of the corresponding broad ligament. At the point of rupture the wall of the sac is quite thin, bulging laterally, infiltrated with blood, and separated from the ovum by clotted and fluid blood. In the ovular cavity is an ovum of about 2 months' development, in active evolution. In the amniotic sac, filled with a serous, light yellow liquid, is an embryo 7 millimeters in length. Placental tissue covers about two-thirds of the surface of the ovum. Blood clots and fluid blood has separated the ovum from the lateral wall of the sac.

The round ligament to the right is attached on the antero-inferior aspect of the cornual tumor, 3 or 4 millimeters lower than the insertion of the tube. The left round ligament is attached to the antero-superior surface of the left uterine horn, a trifle lower than that of the opposite side.

The left tube, of normal shape and length (9 centimeters), communicates freely with the uterine cavity. The right tube, of normal shape and measuring likewise 9 centimeters, opens freely into the ovular cavity. A fine stylet, introduced into its interior, passes through the lumen of the isthmic portion into the ovular wall.

Both ovaries, in good condition, have been left in place. The right ovary contains a corpus luteum on its lateral extremity. (We have been unable, for lack of laboratory facilities, to secure a histological examination of the specimen.)

CLINICAL ASPECTS

Interstitial pregnancy manifests itself by variable symptoms, resembling those of other forms of ectopic gestation. The early stage is disclosed, as in both of our cases, and as indeed it is in almost all the published cases, by a delay in menstruation (a delay of 15 days in both our cases) followed, as in our Case 1, by the expulsion of a deciduum, with profuse metrorrhagia. The physical findings are quite variable. There are anatomic forms where the ovular sac is fused with the uterus, incorporated with it, so to speak, the uterus becoming, as in our two cases and in those of Maygrier, Bonnaire and Brac, Rosenthal, Waegeli, Vaudescal, etc. more or less asymmetric. In other forms, the interstitial gestation is clearly distinct from the uterine body as in the cases of Bosse, Léopold, Henkel, Bar and Buffnoir, etc. Between these two types may be found every anatomical intermediary. The variation in the anatomical characters depends according to Vaudescal upon the point of primitive implantation of the ovum and upon its age and its stage of evolution. The result is an extremely variable appearance of the utero-ovular mass, such that an anatomical diagnosis, in certain complex cases, cannot be arrived at even with the lesion in plain sight at the laparotomy.

However, in the majority of cases, upon determining the presence of one or several of the classical characteristics of intramural implantation of an ovum, the existence of an interstitial pregnancy may be determined by simple macroscopical examination of the specimen. There are three principal characteristics which should be considered, viz., asymmetry of the uterus, asymmetry of the adnexa, and lateral insertion of the round ligament.

Uterine asymmetry. Ruge-Simon's sign. This sign exists in the majority of cases (Waegeli) and is characterized by elevation of the fundus on the side of the abnormal horn. Under the influence of the abnormal insertion of the ovum into one of the uterine

horns and of the habitual tendency of an interstitial gestation to develop upward at first, by reason of the conformation of the interstitial portion of the tube (Vaudescal), there occurs a verticalization of the fundus of the uterus producing a cone-shaped organ.

According to Lequeux the presence of the Ruge-Simon sign depends upon the primitive seat of implantation of the ovum. When the nidification occurs in the musculature of the fundus, the ovum develops in an ascending direction producing the sign. When the implantation occurs in the musculature of the lateral wall the Ruge-Simon sign is absent. We have seen in Case 1 that the ovum, instead of developing upward, grows outward from the left lateral border of the uterus, giving rise to the natiform appearance of the extirpated specimen. In Case 2 on the contrary, the asymmetry was due to the ascending or vertical development of the process in the right uterine horn.

Asymmetry of the adnexa. Under the influence of an abnormally developed pregnancy, the tube on the gravid side is usually drawn upward by evolution of the ovum, which produces the asymmetric attachment of the adnexa. The constancy of this anatomical condition is associated with the uterine asymmetry. Here, as for the uterus, Lequeux holds that the respective situation of the adnexa depends upon the nidification and the direction of evolution of the abnormally implanted ovum. When the evolution of the gestation is vertical, the corresponding tubal insertion is drawn upward; when the ovular sac develops downward, the insertion of the tube will be lateral or descendant (Cases of Lequeux, Rosenthal, Glaesner, C. Daniel, etc.) in relation to that of the opposite side, thus producing adnexal asymmetry. In Case 2, despite the ascending position of the ovum, the tubal insertion is scarcely higher on the gravid side.

Lateral insertion of the round ligament. In general, the round ligament of the gravid side is attached lateral to the fœtal tumor, and is displaced laterally together with the tube by the development of the ovum. The insertion of the round ligament varies according as the tube is attached, also, as Lequeux remarked, it varies with the anatomical conditions and the direction of development of the ovum. It may be implanted in the center of the lateral aspect of the ovular mass (Vaudescal); it may be displaced downward (when the gestation has evolved upward, as occurred in both our cases); finally, it may be displaced upward (when the gravid process evolves downward), and it may even be found medial to the gestation mass, as in the cases of Wagner and Lequeux.

Unfortunately none of the anatomical characteristics which we have just described offers any help of clinical value, since in our two cases, as in all published cases, the diagnosis was not established until after examination of the specimen removed at laparotomy. Nevertheless in a thin woman with a flaccid abdominal wall, one might, by palpation, study the situation of the gravid tumor in its relation to the uterus and even the position of the round ligament in its relation to the ovular mass, and thus formulate a possible diagnosis of interstitial gestation. The asymmetry of the gravid uterus (Ruge-Simon sign) and especially the situation of the tumor in front of the uterus, should, according to Professor Bar (1) suggest a pregnancy, either interstitial or cornual (variety which transforms itself into a uterine pregnancy).

The posterior situation of the tumor, in the cul-de-sac of Douglas, is found oftener in tubal pregnancies, properly called. Again when palpation discloses the round ligament attached lateral to the cornual tumor, the possibility of an interstitial gestation is suggested rather than the classic tubal pregnancy. Numerous diagnostic errors are recorded. In Case 1 we confused the unruptured gravid intramural process for a fibroid. In Case 2, with uterine gestation in mind, a colleague did two successive curettages to produce abortion.

Clinical development of interstitial pregnancy is analogous to that of the usual extrauterine gestations. It may become arrested in its development as in Case 1, where a small intact ovum was found in the left horn of the uterus. Exceptionally, interstitial gestation progresses unruptured to the fifth month

(case of Brindeau) and even to the seventh month (case of Bar and Buffnoir). Usually, however, a rupture occurs toward the end of the second month, resulting in either a massive peritoneal hæmorrhage (inundation) or an encysted hæmorrhage (hæmatocele). In Case 2, at about second month from date of last menstrual period, the patient experienced severe hypogastric pains and syncope, and at operation the ovular sac was found ruptured, and there was a peritoneal hæmorrhage of moderate grade. The average age of the patients is 32 years (Villette) for all kinds of ectopic pregnancy. In our first case the patient was 26 years and in the second, 42 years.

ANATOMICAL CHARACTERS

Macroscopic anatomy of the uterus and ovular tumor presents variations in appearance, to which reference has already been made in the general clinical description of the two cases. Alterations occurred in the opposite adnexa in 50 per cent of the cases. The tube and ovary may show every possible alteration. Ordinarily the usual lesions occur, consisting of peri-adnexitis and ovarian microcysts. In our second case the adnexa presented the ordinary chronic inflammatory lesions. In the case reported the condition of the adnexa on the side involved appeared to be normal. Histological study of this condition is extremely important and has been particularly stressed by Waegeli and by Vaudescal, and others. Microscopical study of an interstitial gestation should include a study of the ovular cavity, uterine cavity, both tubes, and both ovaries.

The ovular cavity. This is embedded in the musculature of the uterine wall. The wall of the cavity consists of a thick, smooth, muscular layer covered on the outside by peritoneum and on the inside by a connective-tissue lining containing decidual cells. According to the majority of writers, especially Vaudescal, a slightly marked decidual reaction is found in interstitial gestation at the point of implantation of the ovum, exactly as is found in tubal pregnancy. Certain authors—Martin, Beckmann, Simon, Webster, von Franque—state that a true tubal decidua is found about the walls of the sac which develops at the expense of the tubal mucosa. Other authors—Aschoff, Griffith, Kuhne, Poppel, Futh and Ulesho-Stroganova, cited by Vaudescal—deny absolutely the existence in interstitial pregnancy of decidual reaction of the periovular tissue, as is found in the tubal variety of ectopic gestation. Popper believes that the absence of decidua is one of the characteristic histological findings in interstitial pregnancy. According to the researches of Vaudescal glandular structures indicative of uterine or tubal mucosa are not found at any point.

As the ovum hollows out its location in the uterine musculature, there develops an intimate connection between the chorionic villi and the muscular tissue of the wall of the sac (canalicular or intramural). Very often at places the chorionic villi deeply invade the uterine musculature producing fusion between the migratory ovular cells and the muscular fibers (Vaudescal), thus explaining the rupture of the sac. It is generally believed that decidual transformation of the uterine mucosa is present in interstitial as in all other forms of ectopic gestation (Kussmaul, Beckmann, Couvelaire. According to Vaudescal "the reaction of the uterine mucosa as in all extra-uterine pregnancies is probably variable." In his researches this author found undeniable examples in which the uterine mucosa had not been transformed into decidua. Thus the integrity of the mucosa of the uterine horn and of the mucosa of the isthmic portion of the corresponding tube, would permit the confirmation of an interstitial gestation.

Histological examination shows that the tubes and ovaries are normal on both the gravid and non-gravid sides.

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ESSENTIAL HÆMATURIA

A Clinical Study[1]

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ESSENTIAL or idiopathic hæmaturia is a condition of renal bleeding the etiology of which cannot be determined. It is a clinical diagnosis which is offered when all the present known urological methods have been employed with negative results. The literature is full of theories as to its possible pathology; even the most careful gross and microscopical studies of kidneys removed to save a patient from exsanguination have not yielded constant findings. Many of these have been reported normal; others have shown small isolated areas of chronic interstitial and glomerular nephritis (1), while other kidneys have had nothing but chronic passive congestion, due to obstruction of the urinary outflow or of the blood supply (2), or congestion secondary to cardiac lesions, to explain the hæmaturia. Varices of the papillæ (Fenwick, 3) have been found on sagittal section of the kidney in some of the cases. The theories of hæmophilia (4), and angioneurosis (5) have been offered as an explanation for idiopathic hæmaturia. Hunner (15) believes that ureteral strictures may play an important rôle, and E. L. Young (16) regards obscure hæmaturia as a prenephritic symptom.

It is quite evident that there is no one accepted explanation for a hæmaturia with negative urological findings. From a study of the kidneys removed at operation a single pathological entity cannot be made to apply in all cases; it is quite possible that different factors are responsible. If there is no agreement as to the etiology of essential hæmaturia, clinically however, we deal with this condition as a definite disease the diagnosis of which is always arrived at by exclusion.

It is important to have employed all the diagnostic methods at our command before venturing the diagnosis of essential hæmaturia. The patient should have a careful history and a general physical examination, which should include emphasis on the symptoms and signs of nephritis, tuberculosis, and calculi of the urinary tract. The bladder urine should be examined chemically and bacteriologically; and phenolsulphonephthalein excretion estimated for a period of 2 hours. A Wassermann test of the blood should be done in all cases. The patient should be cystoscoped, the ureters catheterized, and the urine from each kidney examined for pus and infection, including an examination for tubercle bacilli. A differential phthalein, with the estimation of the phthalein excretion for 30 minutes, the urea percentage, a plain roentgenogram of the renal, ureteral and bladder region, a pyelogram and uretergram of one or both sides must be part of the routine. In suspicious cases it may be well to pass a wax-tipped catheter to rule out calculus.

If, after all these investigations, it is found that the patient has no urinary symptoms other than hæmaturia, the physical examination is negative for tuberculosis and nephritis, the urine free of pus cells, casts, and infection, the phthalein excretion within normal limits, cystoscopy negative except as a determining factor of the source of the bleeding, the urine from the bleeding kidney negative for pus and infection and with a normal function, and the pyelograms negative, it may then be concluded that we are dealing with a case of essential hæmaturia. One is never justified in making a diagnosis of essential hæmaturia when the examinations are incomplete or puzzling.

This paper is a clinical analysis of 30 cases diagnosed essential hæmaturia (28 from the service of the Brady Urological Institute and 2 from the gynecological service of the Johns Hopkins Hospital), based on clinical studies of the cases and supplemented by

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conclusions drawn from the replies to a questionnaire. The questions were framed to include the possibility of subsequent development of nephritis, urinary tuberculosis, calculi of the urinary tract, renal colic, operative procedures upon the kidney involved, and recurrence of hæmaturia. A few of the cases have not been worked up as completely as one might wish, and the explanation is that they belong to a period when urological investigation was not as thoroughly developed as now.

In this series of cases patients have been followed from 1 month to 13 years, viz.:

	Cases
Less than 1 year	4
1 to 2 years	5
2 to 5 years	11
5 to 10 years	9
Above 10 years	1
Total	30

Two-thirds of the cases are, therefore, represented as under observation for a period of less than 5 years, and one-third of them between 5 and 10 years.

Sex. There are 24 males and 6 females in the series. It would be unfair, however, to assume that essential hæmaturia is more common among men than among women as most of the cases were drawn from the Brady Clinic, where the majority of the patients are males.

Age. The ages of the patients when they first presented themselves for treatment at the Johns Hopkins Hospital vary from a minimum of 10 to a maximum of 71 years.

	Cases
Under 20 years	3
From 20 to 29 years	1
From 30 to 39 years	5
From 40 to 49 years	9
From 50 to 59 years	6
From 60 to 69 years	4
From 70 + years	2
Total	30

The age incidence of the actual onset of the hæmaturia, as determined from the duration of symptoms, is as follows:

	Cases	Percentage
Under 20 years (6, 10, 10) approximately	3	10
From 20 to 29 years	4	13.4
From 30 to 39 years	4	13.3
From 40 to 49 years	11	36.6
From 50 to 59 years	3	10
From 60 to 69 years	3	10
From 70 + years	2	6.7

In more than one-third of the cases the onset of the hæmaturia was in the fourth decade of life; this represents also the period for the patients most commonly to present themselves for treatment. That blood should appear in the urine for the first time in eight cases between the ages of 50 and 70 is extremely interesting and most important for ruling out the presence of renal or vesical tumor. The youngest individual in whom hæmaturia was noted for the first time was 6 years of age and the oldest 70 years. Essential hæmaturia is not especially a disease of young individuals, as the onset of the bleeding occurred in only 7 cases before the age of 30 years.

Symptoms. Essential hæmaturia is usually symptomless. In this series of 30 cases 13 had had some symptoms accompanying the hæmaturia; these varied from slight pain in the back to typical renal colic attacks. The remaining 17 cases were free from symptoms.

Six cases (3, 8, 14, 20, 21, 23) had mild symptoms—pain in the back or lumbar region—which might have been ignored by the patient if not questioned about them. Urinary symptoms were quite prominent in Case 14, and these may easily have been due to the accompanying prostatitis.

Four cases (11, 17, 22, 25) of essential hæmaturia had suggestive renal colic attacks during the period of bleeding. These were undoubtedly the result of the passage of clots down the ureter.

Glancing over the list of cases with symptoms, one is impressed with the fact that periods of painless hæmaturia alternate with periods when symptoms accompany the urinary bleeding.

Etiology. The pathology of essential hæmaturia is still in dispute. Sex apparently is of no significance. Exertions and injuries play no important rôle though they are mentioned in three cases. In one (Case 29) hæmaturia developed after exercise. In another (Case 23) a blow on the right side of the back was followed by hæmaturia 10 days later, which subsequently proved to be coming from the left kidney. In the majority of cases the hæmaturia developed spontaneously.

Kidney involved. The blood came from the right kidney in 17 cases (57 per cent) and from the left kidney in 13 cases (43 per cent). In no cases were both kidneys involved, at least simultaneously. These observations are in accord with those of most observers, who have reported essential hæmaturia as a unilateral affection of the kidney.

Treatment. The treatment of essential hæmaturia is an interesting phase of urological history. With the advance of urology, the treatment of these obscure hæmaturias has changed. Before the technique of ureteral catheterization was perfected, the therapeutic tendency was operative. Within recent years, however, intrapelvic treatment through the ureteral catheter has been the form of treatment generally employed for these conditions.

In reviewing the literature, one is at once impressed by the numerous claims advanced for the treatment and cure of essential hæmaturia. The procedures have been operative and non-operative. In the former decapsulation, nephrotomy, and, occasionally, nephrectomy have been employed. In the non-operative the hæmaturia has often ceased with the mere passing of a ureteral catheter (Timberlake, 7) or with the injection of adrenalin (Young, 8; Caulk, 9), silver nitrate (Geraghty, Rytina, 6), or serum (Barringer, 10) into the renal pelvis. Sometimes the bleeding has stopped spontaneously. At times the oral administration of calcium lactate, the subcutaneous or intramuscular injection of horse-serum, or the employment of transfusion (11) has helped to clear up a stubborn case of unexplained origin. Focal infections have been sought for and, when removed, have often caused a disappearance of the hæmaturia (Case 12).

Treatment is intimately bound up with remissions and cure, and in essential hæmaturia it is indispensable to consider recurrences of bleeding along with treatment. The literature is full of references to cures of an unexplained hæmaturia by some special form of therapy. Too often the cases have not been followed for a sufficient length of time to judge of the efficiency of the treatment, for patients with hæmaturia, as is well known, have periods of hæmaturia alternating with periods of no bleeding that occur spontaneously. It is well to bear in mind, when any new suggestions for treatment are offered, that they may represent a temporary cessation of the bleeding and not a cure. From the study of our cases we find that two of the patients (Cases 23 and 24) had recurrences for the first time after 12½ and 7 years respectively, prior to which they were apparently free of hæmaturia We have thought it best to avoid claims for cure and have grouped our cases conservatively as "Recurrences" (Table II) and "No Recurrences" (Table I).

Of the series of 30 cases, 5 had operative interference for the control of the hæmaturia (Table III); nephrotomy 3 cases, decapsulation 1 case, and nephrectomy 1 case. In the last case (28) the loss of blood was so excessive that a nephrectomy was done to save the patient's life. The postoperative improvement was marked, the hæmoglobin rising from 25 per cent to 60 per cent. At operation an apparently normal-sized kidney was found. On splitting it the pelvis was found filled with a blood clot. There was a gush of blood from the kidney itself, showing that the vessels were intensely engorged. Both on the surface and on section the kidney looked normal. There was no gross lesion to account for the bleeding. Microscopically, the kidney showed nothing remarkable; a few small collections of round cells were apparently the only pathological evidence.

One of the patients (Case 26) had a decapsulation of the left kidney (New York surgeon) in 1911. For 5 years the urine was apparently free of blood. In 1916 the hæmaturia recurred and there have been three recurrences since the operation.

Three nephrotomies are included in the operative list. In one (Case 27) the hæmaturia has as yet not returned over a period of almost 8 years; but in the other two (Cases 24 and 25) recurrences occurred respectively 2½ and 5 years after the operation. In these nephrotomies the kidneys were opened from pole to pole, but nothing grossly abnormal was discovered either in the renal parenchyma or in the pelvis. In one (Case 25), however,

Table I.—Cases of no Recurrences of Hæmaturia

Date of Admission	Case No.	Age in Yrs.	Period of Hæmaturia	Symptoms	Clinical Findings — Kidney Involved	Treatment	Period Free of Hæmaturia	Present Urinary Symptoms	Present General Health	Present Age in Years
Feb., 1912	5	63	Painless hæmaturia for 2 months.	Dull pain in right back.	Right. Normal functions. X-ray and pyelogram negative.	Pyelogram. Hæmaturia ceased after pyelogram.	7½ years	None	Good	70
Nov., 1911	27	71	11 months	Painless	Right. X-ray negative.	Nephrotomy	7½ years	Nycturia 2 – 3 times.	Good	80
Mch., 1913	3	41	3 weeks	Slight pain under costal margin.	Right. X-ray and urine negative.	Spontaneous	6 years	None	Good	54
Aug., 1917	6	42	18 months	Painless hæmaturia. Occasional pain left back.	Right. No infection, normal function X-ray and pyelogram negative.	Pyelogram	2 years	None, except for occasional "smarting" on urination	Good	44
Oct., 1917	8	29	2 months	Painless. Occasional pain in left lumbar region.	Left. No infection, no casts; normal function. X-ray and pyelogram negative	Pyelogram. Horse serum and $AgNO_3$ (3 per cent) twice in left kidney pelvis.	1½ years	None	Good	31
June 1918	7	63	1 week, 1910 1 week, 1911 2 months, 1918	Painless hæmaturia. Nycturia once.	Left. No infection, no casts. X-ray and pyelogram negative except nephroptosis.	Pyelogram	6 months	Nycturia 2–3 times.	Good	64
Dec., 1919	28	53	6 months constantly	Painless	Right. No infection. No tubercular bacilli. X-ray and pyelogram suggestive of tumor.	Pyelogram. Injection of pelvis with 5 per cent $AgNO_3$ and adrenalin; finally, nephrectomy.	6 months	None	Good	53
Jan., 1919	2	33	2 weeks in 1912. 2 months in 1918.	Painless. Occasional pain after urination in glans penis. Occasional nycturia.	Left. No infection, no casts, no tubercular bacilli. X-ray and pyelogram negative.	Pyelogram	6 months	Nycturia once. Slight pain on urination.	Good	33
Feb., 1919	4	40	6 months constantly	Slight change in size and force of stream.	Right. Normal function; no casts, no infection, no tubercular bacilli X-ray and pyelogram negative.	Complete distention of pelvis with 5 per cent $AgNO_3$.	4 months	None	Good	40
July, 1919	1	50	2 years	Some pain in right back 15 months ago.	Right. No infection, no casts, no tubercular bacilli. X-ray and pyelogram negative.	Pyelogram	3 months	Nycturia once	Good	50
Sept., 1917	9	26	2 weeks	Painless	Left. No infection. Good function.	Pyelogram. Horse serum, calcium lactate.	2½ years	None	Good	29
Oct., 1920	10	10	Intermittent for 4 year	Occasional frequency Pain in back.	Left kidney; urine negative; no infection; bladder normal function normal; pyelogram negative.	Pyelogram. Urine clear 2 days later.	1 month	None	Good	10

Table II.—Cases of Recurrences of Hæmaturia

Date of Admission	Case No.	Age in Yrs.	Period of Hæmaturia	Symptoms	Clinical Findings	Treatments	First Recurrence	Total Number of Recurrences	Latest Period Free of Hæmaturia	Period Under Observation	Further Treatment	Present Urinary Symptoms	General Health
Dec., 1906	23	36	16 months constantly	Painless hæmaturia; slight pain in right back.	Left kidney. No casts; good function; no infection; X-ray negative.	Hæmaturia disappeared completely in 3 weeks after injection of adrenalin in pelvis of left kidney.	12 years later.	One (1)	Hæmaturia at the present time.	12½ years	Passage of ureteral catheter; hæmaturia persists.	Hæmaturia. Pain in left lumbar region	Good
May, 1909	24	18	Constant hæmaturia for 1½ months.	Painless; nycturia once.	Left kidney	Hæmaturia disappeared after nephrotomy.	5 years later.	3	2 months	10 years	1st recurrence, $AgNO_3$, pelvis; 2nd recurrence, $AgNO_3$, pelvis; 3rd recurrence, spontaneous.	Nycturia once; voids every 2 hours.	Good
Sept., 1910	15	56	1902, 1 month painless hæmaturia. Irregular intervals 1907–8, 3 months continuous.	Painless. None	Right kidney. No casts, infection or albumin. Slight degree of renal impairment.	Injection 1:3000 adrenalin in pelvis right kidney. Hæmaturia disappeared a few days after discharge	3 years later.	1	5 years	9 years	None	Nycturia once.	Fair
Mch., 1910	25	38	Intermittent hæmaturia for 19 years. Constant hæmaturia for 4 months.	Painless	Left kidney. No casts nor infection. Fair function. X-ray negative.	Nephrotomy. Urine cleared immediately after operation.	2½ years later.	Intermittent for 7 years.	æmaturia at present	9 years	None	Hæmaturia painless; nycturia once.	Bad
June, 1911	20	43	Constant hæmaturia for 11 months.	Painless hæmaturia. Dull ache in hips and right loin.	Left kidney. No casts, no tubercle bacilli. Good function. Pyelogram and X-ray negative.	Complete distention of left pelvis with adrenalin; urine clear 8 days later.	1 day. 7 years later.	1	8 months	8 years	Intrapelvic treatment. Dull pain in small of back.	None at present.	Good
Jan., 1915	13	70	7 months continuous	None, except painless hæmaturia.	Right kidney. Diminished function due to enlarged prostate. X-ray and pyelogram negative	1. 5 per cent $AgNO_3$. 2. 1 3000 adrenalin injected into pelvis. 3. Horse serum. 4 $AgNO_3$ injection into pelvis	2 months later.	2	3½ years	4½ years	None	Nycturia once	Good
June, 1915	14	30	Hæmaturia 2 months in 1912; 4 months continuously.	Frequency; nycturia; painless hæmaturia.	Right kidney. No casts, albumin, no infection. X-ray and pyelogram negative.	Urine cleared fifth day after injection of 5 per cent $AgNO_3$ into pelvis of right kidney.	2 years later	1 6 months	2 years	4 years	4 per cent $AgNO_3$ injection of right pelvis for recurrence.	Voids frequently; some pain on urination. Nycturia once.	Fair
Sept., 1915	11	55	2 weeks, June, 1915	Renal colic in 1912. Painless hæmaturia.	Right kidney. No infection. no casts; good function; pyelogram suggest. pathol.	Injection 3 per cent $AgNO_3$ into right pelvis. Repeated 3 weeks later.	2½ years later.	1 2 weeks	1½ years	4 years	3 per cent $AgNO_3$ injected into pelvis right kidney for recurrence.	None	Very good
May, 1916	26	5[illegible]	Irregular attacks 1911–18.	None. Painless	Right kidney. No infection, no casts; function good. Thorium and X-ray negative.	Decapsulation in 1911. Recurrence in 1916. Horse serum used.	1 year later	3	1½ years	3 years	$AgNO_3$ into pelvis.	Nycturia once	Good

Sept., 1916	17	57	Attacks of renal colic. Hæmaturia 11 weeks continuous.	Painless. Nycturia once.	No infection, some casts. Thorium and X-ray negative. Good function.	Urine clear on examination.	8 months later	2	2 months	3 years	Injection of $AgNO_3$ 1917 in right kidney pelvis. Horse serum. Urine cleared afterward.	Nycturia once. Some pain in bladder.	Goo
Aug., 1916	18	41	Intermittent for 10 years.	Painless	No infection. Right kidney. No casts. Pyelogram negative.	20 ccm. horse serum also $AgNO_3$ and adrenalin into pelvis of kidney.	6 months after discharge.	6	11 months	3 years	None	Nycturia once	Very good
Nov., 1916	22	43	Intermittent for 13 years.	Some pain in right lumbar region.	Right kidney. No infection, no tubercular bacilli. Tortuous dilated ureter.	2 pyelograms after which hæmaturia disappeared.	1½ years later	1	7 months	3 years	None	Frequency every hour.	Good
Jan., 1917	16	65	6 weeks continuous 1913 for two days.	Painless. None	Left kidney. No infection, no casts. Thorium and X-ray negative.	Adrenalin injected left kidney pelvis; 10 c.cm. horse serum. $AgNO_3$ pelvis of kidney	1 year later.	1 3 months	1⅔ years	2½ years	$AgNO_3$ injected left kidney pelvis.	None	Excellent
Nov., 1917	19	38	4 months intermittent	Painless	No infection, no tubercular bacilli. X-ray and thorium negative Right kidney.	Pyelogram	1½ years continuous bleeding.	None since Feb. 1 1919.	6 months	2 years	None	None	Good
Jan., 1918	12	48	6 weeks continuous	Painless. None	Left kidney. No infection, no casts. Function good.	Urine cleared up after pyelogram within 2 days.	3 days later	1	1 year, 2 months	1½ years	June 7, 1918, two teeth extracted.	None	Good
Oct., 1918	21	63	10 months continuous	Painless; nycturia 4 to 5 times for 2 weeks.	Left kidney. No infection, no casts. No tubercular bacilli X-ray negative Pyelogram showed calyces broader than normal	Hæmaturia disappeared after pyelogram.	1 week	1, Oct 1918 to April 1919.	3 months	1 year	None	Variable nycturia. Frequency.	Good
May, 1919	29	46	Renal colic May, 1908 Painless hæmaturia for 6 months.	Painless	Left kidney. No infection Good function X-ray negative.	Injection adrenalin left pelvis.	No improvement in hæmaturia for one year.	Intermittent	7 years	8 years	None		Dead October, 1918.
Sept., 1909	30	44	Hæmaturia in 1906 for 5 days; intermittent hæmaturia for 4 months.	Painless	Right kidney	Adrenalin, right pelvis (twice).	8 months	2	5 years	6 years	None		Dead May 1915.

TABLE III.—OPERATIVE CASES

Case Number	Operation	Result
28	Nephrectomy, Jan., 1919	Cured — 6 months
27	Nephrotomy, Dec., 1911	No recurrence in 7½ years.
24	Nephrotomy, July, 1909	Recurrence of hæmaturia 5 years later with two recurrences since
25	Nephrotomy, March, 1913	Recurrence of hæmaturia 2½ years later with five recurrences since. Bleeding at present.
26	Decapsulation, July, 1911	Recurrence of hæmaturia 5 years later with three recurrences since.

the operative note reads that the kidney substance was anæmic with a suggestion of a mild chronic diffuse nephritis. No evidences of recent inflammation, calculi, varices, or tumor were found. In all, the ureters were normal. Small portions removed at operation from each kidney revealed nothing but cloudy swelling. Our nephrotomy results are at variance with those of Payne (12), who as late as 1913 wrote: "In not a single case reported in the literature has this procedure of simple nephrotomy failed to relieve this so-called essential hæmaturia."

The non-operative methods of treatment are varied. The more usual ones are intrapelvic injections, passing a ureteral catheter, subcutaneous or intramuscular injections of horse serum, and oral administration of calcium lactate. Of these, the injection of adrenalin and of silver nitrate into the renal pelvis is the present method of choice. Before reviewing our results of the non-operative treatment we desire to call attention to some interesting experiences in Case 4.

The patient was admitted to the hospital February 8, 1919, with a history of hæmaturia of 6 months' duration, which was diagnosed essential hæmaturia of the right kidney, after careful urological study, before he was admitted. On the day of admission 5 cubic centimeters of silver nitrate (5 per cent) were injected into the pelvis of the kidney. The urine showed some tendency to clear but remained bloody. On February 26, 6 cubic centimeters silver nitrate (5 per cent) were again injected through the ureteral catheter, with no improvement. On March 3, 10 cubic centimeters horse serum were injected subcutaneously, still with no effect on the hæmaturia. On March 8, the pelvis of the kidney was completely distended with silver nitrate (11 cubic centimeters). For 2 days the patient bled profusely, passing large clots, and he complained of pain in the lumbar region. Soon, however, the urine began to clear and on discharge, 12 days after the last treatment, the urine was clear and microscopically free of blood. There has been no recurrence for 4 months.

We have a suggestion to make in intrapelvic therapy for idiopathic hæmaturias. The mere injection of a fluid may not be sufficient to stop the urinary bleeding. The fluid must often be made completely to distend or overdistend the pelvis until the patient begins to complain of pain in the lumbar region. As far as can be determined, Braasch (13) was the first to use this method in essential hæmaturia.

In Case 4 two injections of 6 cubic centimeters silver nitrate had no effect on the bleeding, and it was not until the pelvis was completely distended with 11 cubic centimeters that the hæmaturia finally disappeared. We believe that the mechanical distention of the renal pelvis may produce a cessation of the bleeding in some of the essential hæmaturias. The distention must also be more than momentary; it must be kept up for a few minutes, best produced by plugging the distal end of the ureteral catheter. This form of therapy lends itself to the recent descriptions by Quinby (14) of two cases of essential hæmaturia where the source of the bleeding was apparently just beneath the epithelium of the pelvis and papillæ. As stated before, we believe that the pathology of the obscure hæmaturias is not constant for all cases, and that the etiological factors may be different in each group of cases. Hence, any suggestion for the control of renal hæmorrhage should be taken seriously and employed when methods already used have had no influence on the condition.

The theory of pelvic distention is supported somewhat by an analysis of our cases. In reviewing them we were struck by statements in the history that the patients often left the hospital, apparently after no treatment, with clear urine. A careful study of the charts, however, soon revealed that many of these patients had a pyelogram done in their routine examination. A pyelogram with gravity flow is really a distention of the renal pelvis. (In tables I and II "pyelogram" is meant to signify pelvic distention.) It is quite possible that filling the pelvis with the pyelographic medium may have caused a cessation in some of the cases. It is extremely interesting to note that of the 12 cases with no recurrences the hæmaturia appeared to have subsided in 6 (Cases 1, 2, 5, 6, 7, 10) immediately or soon after no other treatment than the injection of some fluid into the pelvis for a pyelogram. In cases with recurrences

there was a temporary cessation of bleeding for varying periods after pyelography in 3 (Cases 12, 21, 22).

The mechanical distention of the renal pelvis is not advanced as a cure for essential hæmaturia, but is strongly advised in all cases where intrapelvic therapy is employed.

Of 12 cases with no recurrences the following treatments were employed:

	Cases
Pyelogram or pelvic distention	7
Spontaneous cessation	1
Nephrectomy	1
Nephrotomy	1
Calcium lactate (orally)	1
Mixed treatment	1

In these cases, 11 surely had no injections of silver nitrate and of adrenalin into the renal pelvis; and in 1 case the treatment was mixed and it is difficult to determine which form of therapy (pyelogram, horse-serum, or injection of silver nitrate) actually caused the cessation of the hæmaturia. Pelvic distention produced the best results, the urine being freed of blood in over 65 per cent of the cases with no recurrences.

Eighteen cases are grouped as recurrences. In 15 of these with the treatment given there occurred cessation of the bleeding immediately or within a short period in the hospital. Two (Cases 24 and 25) had nephrotomies, and in 4 (Cases 13, 16, 17 for recurrences, 18) the treatment was mixed. In 14 cases where intrapelvic therapy was used (8 with apparently no distention—Cases 23, 24, 15, 26, 14, 11, 29, 30—and 6 with distention—Cases 17, 22, 12, 19, 20, 21), it is of interest to note that most of them cleared up within about 10 days. For the first 2 or 3 days following such treatment the urine often became more bloody, accompanied by passage of clots. Soon the urine began to clear, and within a week or 10 days the patient was discharged with urine macroscopically and microscopically free of blood. The cases with no recurrences have responded about the same to intrapelvic treatments. In three (Case 12, pyelogram; Case 19, pyelogram; Case 29, adrenalin), injections into the renal pelvis had no effect on the hæmaturia. In two cases (Cases 19 and 29) the urine continued bloody for respectively 19 and 12 months, and then stopped spontaneously with no recurrences up to date. In Case 12 the extraction of two teeth with abscessed roots was followed by clear urine 5 days later in a hæmaturia which was continuous for 6 months after pelvic distention. There has been no recurrence for 14 months. It is quite evident that most of the cases diagnosed essential hæmaturia that present themselves for treatment, improve rapidly under observation, particularly if pelvic injections are employed. However, there is a strong tendency toward recurrence within varying periods. In fact, the cases regarded as "no recurrences" will undoubtedly show blood in the urine if followed for a sufficient length of time. One patient (Case 23) was rid of his bleeding for 12½ years when it returned after exertion on the farm. Others have not been so fortunate. Two patients (Cases 12 and 21), whose urine cleared within 2 days after a pyelogram, had recurrences within 2 days and 1 week respectively. In 4 cases (Cases 13, 17, 18, 30) the first recurrence took place within a period of less than a year; and in 9 (Cases 24, 15, 25, 20, 14, 11, 26, 22, 16) it occurred within a period of 1 to 5 years.

As the conclusions of this paper are based on the statements of the patients, it is quite possible that when a patient reports that his urine is free from blood it may contain microscopic blood not noticed by the individual. This happened in a case that is not included in this series. In 5 cases (Cases 1, 6, 8, 11, 12), however, who reported their urine as clear, we had an opportunity to examine the urine and found it to be negative.

The follow-up period in no case of recurrence has been less than a year, though there are 6 cases (Cases 1, 2, 4, 7, 10, 28) with no recurrences that have been under observation for 6 months or less. The patients with recurrences have been followed from 1 to 12½ years, with an average of 5 years. Ten cases (Cases 11, 12, 14, 15, 16, 19, 20, 21, 22, 23) have had but one recurrence. There have been three with two recurrences (Cases 13, 17, 30), two with three recurrences (Cases 24, 26), one with six (Case 18), and

two (Cases 25, 29) with intermittent attacks for varying lengths of time. At the time of writing there are but two patients (Cases 23, 25) whose urine is considered bloody. In ten patients (Cases 12, 13, 15, 18, 19, 21, 22, 26, 29, 30) free of hæmaturia at the present time (including two cases—Cases 29 and 30—whose deaths occurred respectively 9 and 5 years after leaving the hospital) the bleeding of the recurrent attacks disappeared spontaneously without treatment. In the remaining six cases (Cases 11, 14, 16, 17, 20, 24) the recurrences were treated with intrapelvic injections, except Case 24, in which, in addition to these, spontaneous cessation of the bleeding also occurred (third recurrence). The lesson to be learned from these studies is, first, that recurrences are frequent in so-called "essential hæmaturia"; and secondly, that the bleeding often disappears spontaneously.

General health. Of the 30 patients under consideration 2 have died (Cases 29, 30); the first from pneumonia at the age of 54 years, 9 years after leaving the hospital and 8 years after the last appearance of blood in the urine; the second was killed in an automobile accident 5 years after leaving the hospital and 4½ years after the dis appearance of the hæmaturia. The renal bleeding, it is evident, was in no way responsible for the death of either patient.

Of the remaining 28 who are alive, the present health is described as good or excellent in 25, as fair in 2 (Cases 14, 15), and as bad in 1 (Case 25, a typical neurasthenic). Even in the 2 cases (Cases 23 and 25) whose urine is bloody at the present writing, the general health is regarded as good in spite of the hæmaturia. It is, indeed, remarkable how little the general condition of the patient is affected by the presence of blood in the urine in these idiopathic hæmaturias. Most of them are robust individuals, going about their business with no discomfort and no complaints other than the hæmaturia. In one case only (Case 28) the loss of blood so threatened the patient's life that a nephrectomy was performed as an emergency measure. Ordinarily, however, the patients do not seem to be influenced by the bleeding, and only occasionally do they develop severe anæmia.

Questionnaire. An analysis of the questionnaires reveals the fact that none of the patients has apparently developed nephritis (absence of œdema and symptomatic headaches), and in those in whom it was possible to obtain a blood pressure reading it was found to be within normal limits (Cases 1, 2, 4, 6, 8, 12, 21, 23) and their urines, when examined, contained no casts. None has had typical renal colic, and none has passed calculi. From the questions asked one is led to infer that urinary tuberculosis has not developed in any case of essential hæmaturia; in fact, tuberculosis in no form has made its appearance. A renal tumor has apparently not developed subsequently in any case of essential hæmaturia; not an individual has had an operation on the genito-urinary tract; and only two (Cases 5, 25) have come to operation (bottle operation for hydrocele, hæmorrhoidectomy, and perineorrhaphy) at any time since the last treatment for the bleeding. Urinary symptoms have been conspicuously absent. Nycturia from one to two times at night has been the most common symptom, and this is not particularly surprising when the ages of 8 of these individuals are known to be above 50 years. In 3 cases (Cases 14, 22, 24) frequency has been present, the first two voiding every 2 hours and the last every hour during the day. With these exceptions, and lumbar and back pains in some of the cases, no urinary symptoms are noted.

Prognosis. From our studies, so-called essential hæmaturia appears not to influence the general health of the patient, nor does it seem to lead to disturbances of the urinary tract later on. None of the patients under investigation has apparently developed nephritis, renal colic, tuberculosis, nephrolithiasis, or renal tumor, and none has come to operation for genito-urinary conditions. Patients have been followed for sufficient time for us to dare offer a prognosis. It appears that we may give patients with hæmaturia, with negative urological findings, a favorable prognosis and assure them that, as a rule, recurrences will not affect the general health.

Only two deaths have occurred in our series and in neither of them has the cause of death been related to the hæmaturia. The question of prognosis in essential hæmaturia appears to be one of the main features of our studies. In view of our findings it does not seem to us justifiable to advise a nephrectomy in the cases with intermittent hæmaturia over long periods. A nephrectomy should be employed as an emergency measure in those cases where life is threatened, or where loss of blood begins to produce definite signs of severe anæmia. As for nephrotomy, we cannot say that the results have been striking (recurrences in 2 or 3 cases); and again, we must condemn nephrotomy on general principles, as we know that this procedure leads to marked destruction of the kidney. Further, in one case of decapsulation there occurred subsequent hæmaturia after a period of no bleeding. On the whole, the operative results have not been better than the non-operative findings. We strongly advise that non-operative therapy be given a fair trial, particularly the methods of intrapelvic therapy with pelvic distention.

SUMMARY

1. The diagnosis of essential hæmaturia should be made only when all known urological methods have been employed with negative findings. It is a purely clinical diagnosis, indicating renal bleeding of unknown etiology.

2. This paper comprises the studies of 30 cases diagnosed as essential hæmaturia, based on clinical studies supplemented by conclusions drawn from a questionnaire, the questions of which were so framed as to include the possibility of subsequent development of nephritis, urinary tuberculosis, calculi of urinary tract, renal tumor, operative procedure upon the kidney involved, and recurrences of hæmaturia.

3. In 36 per cent of the cases the onset of the hæmaturia occurred in the fourth decade of life.

4. The bleeding in essential hæmaturia is for the most part symptomless.

5. In most of the cases the hæmaturia developed spontaneously. Exertion does not appear to play a significant rôle in the origin of these hæmaturias.

6. The right kidney was responsible for the bleeding in 17 cases and the left in 13 cases. In no case were both kidneys involved.

7. The results of operative procedures have not been better than those of non-operative methods. In our series there were recurrences after decapsulation and two nephrotomies. Nephrectomy is the only operation ever indicated, and that only as an emergency measure to save a patient from bleeding to death and not as a routine measure for intermittent hæmaturia over a long period.

8. The non-operative methods have been used with success. These have consisted of intrapelvic injection of silver nitrate and adrenalin, and of the passage of a ureteral catheter; the oral administration of calcium lactate and the subcutaneous or intramuscular injection of horse-serum. Of these the intrapelvic methods have given the best results, and it is of interest to note that in a large number of the cases of the series the urine had become clear within a week or 10 days after this form of treatment.

9. It is suggested that the pelvis of the kidney be completely distended with fluid whenever intrapelvic injections are employed. That distention is an important factor in this therapy is shown in many cases in which the hæmaturia has temporarily disappeared after the injection of an opaque medium for pyelographic studies.

10. The 30 cases have been followed from 1 month to 12½ years. There have been 12 cases with no recurrences of the hæmaturia, and 18 cases with recurrences. Of the latter there are 2 whose urine is bloody at the time of writing. It is not safe to predict cures.

11. Spontaneous cessation of the bleeding occurs frequently in essential hæmaturia.

12. The general health is usually not affected by the loss of blood in essential hæmaturia.

13. From an analysis of the questionnaires, we can easily infer that none of the patients has developed nephritis, renal or ureteral calculus, tuberculosis in any form, or renal

tumor, and none has had an operation on the genito-urinary tract.

14. Prognosis in essential hæmaturia is favorable in spite of the loss of blood and the recurrences of hæmaturia.

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OBSTETRICAL PARALYSIS OF THE PERONEAL NERVE[1]

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PARALYSIS of the peroneal nerve from pressure upon the main trunk of the sciatic nerve in its intrapelvic portion is a comparatively rare condition. It occurs during prolonged or difficult labor, either from direct pressure from a large head in a small pelvis, or from trauma by application of forceps. It may have occurred in a larger number of cases than have been reported, as it may easily be confused with the paralysis caused by direct pressure upon the peroneal nerve as it winds about the head of the fibula, which, in a transient form, is common in obstetrical or gynecological cases, where leg holders have been used.

One might expect to find the condition described in textbooks upon obstetrics, neurology, and orthopedics. On looking over the standard works upon these subjects, however, I have found the condition scarcely mentioned. Shears (1) says: "Obstinate paralysis may result from pressure on nerves that pass over the pelvic brim." DeLee (2) does not mention it at all. Hirst (3) refers to the condition, but indefinitely, and says that the "prognosis is fairly good." Edgar (4) simply speaks of the "general outlook being favorable." Starr (5) does not include it among the causes of injury to the sciatic nerve. Whitman (6), Bradford and Lovett (7), Taylor (8), Tubby (9), and Redard (10) do not mention the condition.

Among the monographs upon the subject I find the following references. Howell (11) reports three cases in which, curiously enough, he states that the onset of the paralysis did not occur until the sixth, second, and ninth days, respectively. All were prolonged labors. Two cases were primiparæ; the other an instrumental delivery. There were no recoveries.

Gordon (12) reports two cases of which he does not give the outcome. Thomas (13) does the same. The earliest reference found is that of Bianchi (14) who says: "These rare paralyses usually follow difficult and prolonged labor, in which the fœtus presents by the vertex and has to be extracted with forceps. The paralysis is almost always unilateral and limited to the distribution of the sciatic nerve. It may be temporary, incomplete or persistent." The majority of the other authors (15) report isolated cases, and say little about differential diagnosis or ultimate outcome.

The following case is therefore reported, as the patient has remained under observation for more than a year.

She was first seen by me at The Hospital for the Ruptured and Crippled, Clinic of Dr. Royal Whit-

[1] From the Hospital for the Ruptured and Crippled, Clinic of Dr. Royal Whitman

man, January, 1920. S. S., Hebrew; married, age 43; chief complaint, paralysis of the left foot. Patient has been married 17 years, and has seven children alive and well; two stillbirths. Previous labors were always easy. Patient was in perfect health up to the time of last labor. Her present illness dates from 11 weeks ago. Labor pains began on a Friday night and continued until Sunday morning when at 10 o'clock forceps were applied and the child delivered with considerable difficulty. It weighed 10½ pounds. and its head was much lacerated. Immediately on her return to bed, the atient was conscious of great pain in both legs, and inability to move the left foot. The pain gradually wore off and on the eighth day postpartum, she attempted to get up, but was unable to walk because of the foot giving way under her. Since then she has been doing her work supporting herself by clinging to furniture. About 1 month ago the power began to return to the flexors of the toes and the calf muscles, which have steadily been growing stronger. No disturbance of sensation has been noticed at any time; no chills or fever followed delivery, and general health has been as usual.

Physical examination showed the patient to be in good condition. She walks with assistance, dragging the left foot. General physical examination is negative. On the left side there is drop foot, resulting from complete paralysis of the extensors of the toes, the tibialis anticus and posticus, and the peronei. The flexors of the toes and calf muscles are apparently normal. The reflexes are normal on both sides. There is no disturbance of pain or temperature sensation, superficial or deep. Motions of both hips are free and painless. There is no sign of injury to the sacro-iliac joints or to the pelvis

The diagnosis lay between two possibilities. (1) Injury to the main trunk of the sciatic nerve, where it crossed the pelvic brim, either by the infant's head or by the forceps. (2) Injury to the peroneal nerve, where it winds about the head of the fibula, from compression of the strap in the leg holder.

The second injury is by far the more common. In my opinion, the evidence against it was that the tibialis posticus was paralyzed, thus evidencing injury to both trunks of the sciatic nerve. This opinion was supported by the history of complete paralysis below the knee, with subsequent improvement of all muscles supplied by the internal popliteal division, except the tibialis posticus. One might also expect, had the paralysis been confined to the single group of muscles supplied by the peroneal nerve, that during the 11 weeks following the injury there would be at least a tendency to the deformity of equinovarus. Such, however, is not the case. Granting, therefore, that there may have been doubt as to whether or not the tibialis posticus muscle was at that time paralyzed, the patient's history of original complete paralysis below the knee, plus the absence of any muscular contraction, point to the original injury having been to both trunks of the sciatic nerve.

The patient was given a brace with a right angled stop joint at the ankle, and baking, massage, and passive motion were instituted. She took these regularly until October, 1920. The gait improved steadily, due to her increased facility in wearing the brace, but no muscular improvement whatever was noted. She was therefore referred to Vanderbilt Clinic, to the clinic of Dr. Louis Casamajor, for a confirmatory neurological examination. The following report was received from Dr. Hubert Howe. "I wish to report the neurological findings in the case of Mrs. S. S., the patient whom you referred to the Vanderbilt Clinic. She presents a typical picture of paralysis of the external popliteal nerve on the left side. The findings are briefly as follows: The gait is 'steppage', the knee being raised high and foot dropped. As the foot is planted on the ground the arch is flattened, due to paralysis of the tibialis anticus. Dorsiflexion of the foot and extension of the proximal phalanges of the toes cannot be performed, which denotes paralysis of the extensor longus and brevis digitorum, and extensor proprius hallucis. Abduction of the foot is impossible as the peroneus longus and brevis are paralyzed. There is subjective tingling in the dorsum of the foot, but no definite objective changes in sensation. The knee and ankle jerks are present and the plantar reflex is of the normal flexor type. The muscles of the antero-external portion of the leg are atrophied, and fail to react to either faradic or galvanic current. Regeneration is taking place as there is no anæsthesia, while subjective tingling and pain on pressure over the nerve trunk are present."

Dr. Howe speaks of regeneration taking place. Such regenerative processes, however, must be exceedingly slow, as no improvement from the standpoint of muscular action has been demonstrable in 15 months.

The differential diagnosis between intrapelvic and extrapelvic injuries of the peroneal nerve will always be difficult. The crucial point in this case was whether or not the tibialis posticus was paralyzed, a point upon which I regret that Dr. Howe did not express an opinion. The weight of published opinion is that paralysis during parturition from

pressure of the forceps, or of the head in the contracted pelvis regularly gives rise to paralysis of the external popliteal nerve alone. Various theories have been advanced to explain this, the most plausible being that the fibers composing this nerve lie directly upon the bony brim of the pelvis, while the other branches of the plexus lie upon the pyriformis muscle. If this opinion be true, the differential diagnosis must rest entirely upon the history. In this case the history showed: (a) pain in both legs; (b) original complete paralysis below the knee, with subsequent rapid recovery of the muscles supplied by the internal popliteal division of the sciatic.

From a consideration of this case therefore, one would conclude that:

1. In any paralysis below the knee occurring after prolonged, difficult labor or instrumental deliveries, the possibility of intrapelvic injury to the sciatic nerve should be borne in mind.

2. An immediate orthopedic and neurological examination should be made, with a view, if possible, to establishing the differential diagnosis.

3. Apparatus should be immediately applied, to prevent deformity, and to enable the patient to get about with the maximum facility.

4. The prognosis as to ultimate recovery should be exceedingly guarded.

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CONGENITAL OCCLUSIONS OF THE INTESTINES

With Report of a Case of Multiple Atresia of the Jejunum

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THE subject of this paper was suggested by a case recently encountered by Dr. Davis in his practice. From an examination of this case and a review of the literature on the subject it has seemed worth while to make a somewhat detailed study not only on account of its interest from the standpoint of congenital pathology but because of its importance as a clinical problem.

HISTORICAL

As a basis for this study and conclusions we have collected from the literature 392 cases of congenital occlusion of the intestines between the pylorus and anus. The earliest case discovered was that by Calder (1733), who described an atresia of the duodenum, and the first exhaustive review of the subject was made by Theremin (1877). Since Theremin's work a number of extensive papers have been written and the accumulated cases examined. The following deserve special mention: Louis Cordes (1901) presented an analysis of 57 cases of duodenal obstruction; Kuliga (1903) collected 189 cases of congenital occlusions of the intestinal tract and examined particularly the question of etiology; Spriggs (1912) reported 24 unpublished cases and reviewed the literature, his paper is to be especially commended for the careful microscopic studies which it records.

It is very difficult to form an estimate of the frequency of the condition. Theremin's observations at St. Petersburg, so frequently quoted, in which there were 9 cases in 150,000 children show no close agreement with the Vienna statistics in which only 2 cases were found in 110,000 children. Miller (1894) found 36 cases of atresia and stenosis in 65,000 autopsies of children at Moscow. Ernst (1916) found 2 cases reported in 41,000 births at the Lying-in Hospital of Copenhagen. Durante (1901) reports 6 from the Maternité of Paris in one year. Apparently imperforate anus is four times as frequent as other intestinal atresias; it is entirely possible, however, that the discrepancy between the two conditions is one of diagnosis rather than a greater frequency of the developmental defect at the junction of the rectum and anus.

There seems to be no point along the intestinal canal where atresia more or less constantly appears. Even in as short a segment as the duodenum, the lesion may be at any point, and in only about 18 per cent is it opposite the papilla. The following table, arranged in more or less arbitrary divisions, illustrates the positions of atresia in the series we have studied.

	Cases
Duodenum, above papilla	59
Duodenum, below papilla	75
Jejunum	60
Ileum and cæcum	101
Colon	39
Multiple atresia	67

Of the multiple cases slightly more than 50 per cent consist of from 2 to 9 occlusions in the jejunum and upper ileum; 20 per cent are in the small intestines and colon while the remainder are scattered. Apparently about 15 per cent of all cases are multiple, and frequently stenosis occurs in addition to the atresias. If we add the multiple cases of the jejunum to the single lesions of the same region it will be noted that occlusion of the jejunum is relatively as common as that of the ileum. This would seem to oppose the frequently repeated suggestion that congenital atresias are due to developmental errors of the vitelline duct and ileocæcal valve.

CLINICAL PICTURE

This can best be described by detailing the history of our case.

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Fig. 1. Shows the viscera in the abdomen. The widely dilated jejunum occupies the left and inferior regions; this contracts suddenly and ends in a blind tube at *a*. The multiple occlusions are on the right. The contracted transverse colon with no great omentum lies just below the stomach.

Fig. 2. Same as Fig. 1, except the dilated jejunum *Jej.* is reflected up and to the right to show the dilated duodenum, *Duo.* and the band of adhesion attached to the jejunum.

M. E. K., female, was born late in the afternoon of October 21, 1920. Birth was uneventful and child seemed well nourished and in all respects normal. The parents, late in young life, were apparently free from constitutional diseases. A sister 10 years old was normal.

History. The first 48 hours the babe seemed normal. The first few nursings were retained, urine was voided regularly, and there was a passage from the bowels. The bowel movement was not examined but it is certain from the later examination of the bowel contents that it was made up of mucus and cellular débris with entire absence of bile. Emesis was first observed about 60 hours after birth and continued to occur immediately following any gastric intake; all efforts to produce a bowel movement failed.

Examination. On the morning of October 26, Dr. S. E. Jacobi, attending, called Dr. Davis in consultation. Infant appeared poorly nourished with facies of irritation and distended abdomen. Catheter could be passed for a distance of 8 to 10 centimeters and a barium enema fluroscopic examination, by Dr. N. C. Prince, showed the large bowel patent and normal to the hepatic flexure. The enema could not be forced beyond this point although there was no indication from the picture that an obstruction existed here. It is probable that the contracture of the colon prevented higher introduction of the enema.

Diagnosis. Congenital obstruction of small intestine, probably near ileocæcal juncture.

Operation. Near noon, October 26, under local anæsthesia, right lower abdomen was opened. The blind end of an enormously distended intestine readily presented, to the side of which was kinked and adhered an appendix-like small intestine, shown at *a*, Figure 1. Without further exploration an external enterostomy was made to this distended end from which there was free drainage of chylous fluid mixed with castor oil administered by mouth a day or two before.

Postoperative course. After returning to bed water was taken freely without emesis, but 6 hours later death ensued, no doubt due to exhaustion.

Postmortem examination. Thoracic and abdominal viscera normal except intestines. The duodenum is in normal position but widely dilated, 20 centimeters, and thick walled; this condition includes the pylorus.

The jejumum is much dilated, 30 centimeters, and thick walled for a distance of 16 centimeters, then suddenly contracts to normal diameter, makes an acute flexion on the dilated portion but without stenosis, continues for a short distance and ends in a blind pouch. After a short hiatus there is a segment, blind at both ends, 9 centimeters long. Other segments of varying length follow: 6 centi-

meters, 2 centimeters, 1 centimeter, 11 centimeters, 17 centimeters. Between some of these segments there is a deep notch cut in the mesentery while other spaces show the mesentery intact and with a thin border. All of the segments of intestine are of normal diameter except the fourth which has a diameter of about twice that of the normal. When examined for total length it is evident that about one-third of the jejuno-ileum is lacking, being represented in the spaces between the blind segments. The ileum and colon are normal except the latter is contracted to appear almost "worm like"; it dilates readily under water pressure (Fig. 1).

There are no peritoneal adhesions except a small band from the proximal dilated jejunum to the dorsal wall. This is represented in Figure 2. The mesenteries are normal in position and development, and contain no points worth note except, in the regions of the atresias, there are many enlarged lymph nodes. The mesenteric arteries are normal in pattern and distribution.

Microscopic examination. All viscera are normal except the intestines. The duodenum and jejunum, up to the point where it ends in a blind pouch, Figure. 1, *a*, show the effect of dilation in the mucosa and muscularis mucosa but the muscular wall is much thickened (Fig. 3). This condition of overgrowth of the proximal gut is probably an hypertrophy due to the obstruction. It has been noted in a number of cases. Ducros (1895) said that in one-third of his cases there was hypertrophy of the wall above the occlusion. Spriggs (1912) thought that this thickening was a serous infiltration; in our case, however, there is no question but that there has been a large increase in the muscular elements.

The colon shows more contracture than the ileum but can hardly be termed "worm-like." The microscopic picture shows no abnormality of development. There are, however, many cases on record in which the distal bowel is underdeveloped and very probably to such an extent that it would be incapable of functioning if the occlusion were successfully eliminated.

The contents of the blind segments is mucus, epithelial débris, many small round cells, and a few red blood cells. The picture is one of a degenerative process such as Mall describes in speaking of pathological embryos, as "disassociation." Many fields look like postmortem changes but we can be reasonably certain that they are not because no such changes appear in other portions of the canal (Fig. 4). This cellular degeneration belongs to the mucosa which in many places can not be distinguished from the contents of the canal. Kuliga (1903) and Spriggs (1912) observed in their cases that the mucosa was most markedly degenerated. The muscularis mucosa is undergoing the same degenerative process but to a less degree. The muscular coats are well differentiated but show atrophy and hypoplasia; the muscle fibers are small and irregular and the nuclei much contracted and deeply staining.

In all but two segments the canal ends blindly with all layers present and no indication of a scar. In two segments, or rather in the space between two segments of intestine, muscle fibers are present in heterogeneous arrangement in the border of the mesentery. This muscle seems to be continuous with the outer muscle coat of the intestine. There is no suggestion of a lumen (Fig. 5).

There is lymphoid infiltration throughout the mesentery and the lymph nodes are enlarged but in our opinion this condition is to be related to the degenerative process rather than to bacteriological reactions. There is no evidence at any point of a folding, twisting, or other disarrangement of the mesentery.

We have already noted that the arteries appeared normal on inspection, but when examined in microscopic section, they present an extremely interesting picture and suggest a cause for the degeneration we have just described. In the regions of mesentery where the gut is wanting the arteries are all sclerosed. The general arrangement of this sclerosis can be best understood by referring to Figure 6. In this drawing the normal arteries are shown in relief in the mesentery while the sclerosed vessels are represented by black lines. All of the arteries in the atresic region show some sclerosis. The process seems to be primary in the smaller radicles. Figure 7 shows a large artery in the margin of the mesentery; its walls are greatly thickened and the lumen small. The smaller arcades and particularly the terminal rami of the free mesenteric border are occluded by an overgrowth of cells which seem to be derived from the endothelium. Figures 8 and 9 show the occluded rami. We have found no other case reported in which this condition of the arteries has been described, but since so few have been carefully studied microscopically it is probable that the condition is not so rare as this statement would indicate. It is unprofitable to speculate as to what caused the local sclerosis, but it seems certain that this case cannot be classed with developmental anomalies.

There are certain points in which our case did not correspond to the more commonly recorded clinical picture which may be profitably considered.

Vomiting is almost always present and generally begins on the second day; Helmholz (1907) reported no vomiting but the child lived only 48 hours. Vomiting of blood is often recorded and frequently appears with the first emesis. The exact cause of the hæmorrhage has not been determined. Cowell (1912) reached the conclusion, that: "In most cases the gastrorrhagia is mechanical in origin, resulting from the strain of vomiting on an

Fig. 3.

Fig. 3. A photomicrograph of a section taken through the dilated jejunum and the contracted blind end. *1*, Is a section of the contracted appendix-like end and *2*, of the dilated portion. *m*, Marks the muscular walls and shows the enormous hypertrophy of the dilated jejunum.

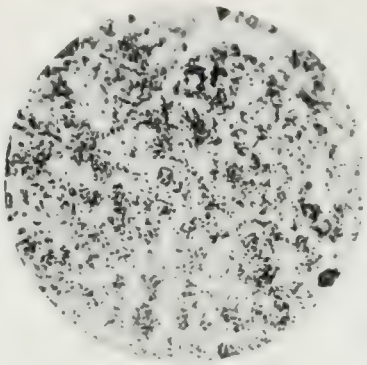

Fig. 4.

Fig. 4. Section through a blind segment near its end to show the degeneration of the mucous membrane.

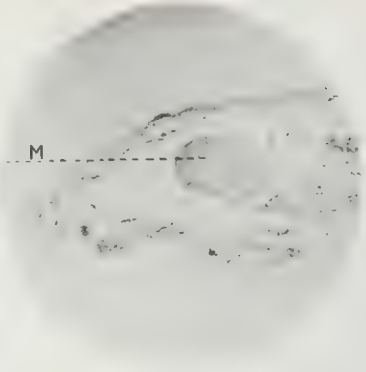

Fig. 5.

Fig. 5. Section through the mesenteric border between two segments showing persistence of muscle coat, *M*, but with entire absence of lumen.

already overdistended stomach." Bile may be vomited even when the obstruction is above the papilla and can only be explained on the basis of an accessory bile-duct, (Cordes, 1901).

Constipation is usually complete when the obstruction is below the bile papilla, but a little greyish mucus may be passed as in our case. If the obstruction is above the papilla scanty green motions are generally recorded.

In a few cases a slight icterus has been observed at birth, Savariaud (1903) thinks it is due to hypertension in the biliary tract. We are under the impression that icterus is not present in a larger proportion of these cases than in normal newborn infants.

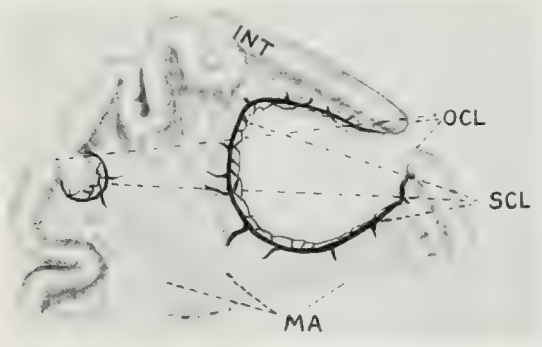

Fig. 6. Drawing to show a segment of intestine, *int*, the mesenteric blood vessels, *ma*, and the position of the sclerosis indicated by the heavy lines, *scl*.

Anuria has been reported in some cases but no cause has been suggested.

ETIOLOGY

In discussing the question of etiology it is important to recognize the dissimilarity of many of the cases. The atresia varies from a simple diaphragm occluding the lumen of the canal to multiple defects of considerable extent, as in our case. The time of occurrence of the lesion is variable. Many cases with the occlusion below the opening of the bile-duct contain normal meconium in the distal bowel, which shows that the obstruction was formed after the third month; other cases with the lesion in the same position show a total absence of bile in the bowel content and would argue for an earlier operating cause.

Developmental errors. Arrest of development as a cause of intestinal occlusion was first suggested by Meckel (1812) who was under the impression that the intestine developed in segments. In 1890 Filimowski and Tandler both found that human embryos between the ages of 4 and 10 weeks show an overgrowth of epithelium in the duodenum which causes, for a short time, an occlusion of the canal. They concluded that this condition might persist and so be the cause of duodenal atresia. Forssner (1907) restudied the question and agreed with the above investigators in their conclusions; he, however,

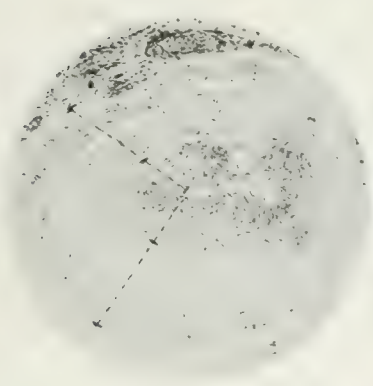

Fig. 7.

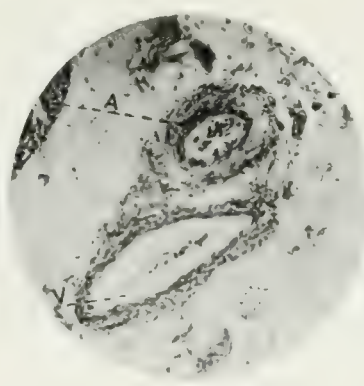

Fig. 8.

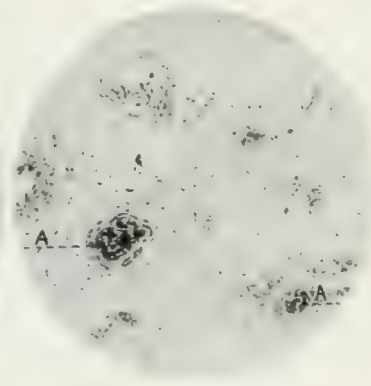

Fig. 9.

Fig. 7. Photomicrograph of a section of one of the larger sclerosed arteries showing the thick wall. The smaller arcades are occluded by an overgrowth of cells which seem to be derived from the endothelium.

Fig. 8. Photomicrograph of a mesenteric artery and vein showing the occlusion of the artery by an overgrowth of the endothelium.

Fig. 9. Photomicrograph of a smaller artery showing sclerosis and complete obstruction of its lumen by degenerating endothelium.

went a step farther and suggested that the same condition of overgrowth of epithelium might occasionally occur in other portions of the canal and so account for occlusions found elsewhere than in the duodenum. Schridde (1908) denies that the duodenum is ever entirely occluded during development. Granting that occlusion normally occurs during development it is difficult to make this fact explain the extensive defects sometimes found in the duodenum, and much more those of the jejuno-ileum and colon.

Bland Sutton's (1889) theory that occlusions occur at the site of an "embryological event," while very satisfactorily accounting for imperforate anus and occlusion at the bile papilla, is not borne out by a study of the distribution of lesions in this series of cases. The statement has frequently been made that these cases are developmental errors because of the large number of other anomalies which are found in association. Such a statement is an error, for in our series there is less than 0.5 per cent of the children showing anomalies; on the other hand the absence of other anomalies is not necessarily an argument against developmental disturbance since all of the more recent experimental teratology shows that there is almost entire independence of lesions. In a certain proportion of our series there is undoubted evidence of developmental disturbance but what the factors are, or how they operate to produce atresias, can, at the present, be only a matter of speculation.

Developmental accidents. Many of the Continental writers have concluded that the condition is due to *Achsendrehung* which may be considered as volvulus. Since various late stages of congenital volvulus have been observed it seems entirely reasonable that this accident is responsible for a number of cases, Gaertner (1883).

Intussusception has been urged by Braun (1902) and Chiari (1903) as the cause of congenital atresia. In the cases which they studied there seems to be no question of the correctness of their conclusions but it is difficult to conceive of this process, or volvulus, acting without disturbance of the anatomical arrangement of the mesentery, which is normal in so many cases.

Strangulation of a loop of intestine at the navel or some other point is without question the cause of a number of cases (Clogg, 1904).

Fœtal pathology. Peritonitis, as the cause of these anomalies was first suggested by Fiedler (1864) who thought that, aside from the atresia, the condition might be so far recovered from as to leave no evidence at birth. This view has been quite widely accepted. A small proportion of this series shows peritonitis still active or evidenced by old adhesions. Enlarged lymphatic nodes in the mesentery are frequently reported, but

it is entirely possible that these are secondary to occlusion of the bowel. It is difficult to understand how peritonitis could produce wide defects in the bowel with blind ends showing no scar; then, too, it is contrary to observation that adhesive bands should draw across a gut so as to sever it in the way that must occur if we are to consider peritonitis as the cause of these cases. It is our opinion that this series of cases offers very little evidence in favor of the inflammatory hypothesis of congenital atresia.

In a certain number of cases ulceration of the bowel has been found and bacteria have been recovered from the site of the atresias. If an ulceration occurred early it might heal leaving only an occlusion at birth. With our present knowledge of fœtal pathology no exact statements can be made but in cases like that of Markwald (1894) and others, microscopic examination strongly supports the view that some factor has caused a degeneration of the mucosa. Our case seems to indicate that *the primary lesion is in the arteries causing a sclerosis and that the degeneration of the mucosa is secondary to this sclerosis.*

DIAGNOSIS

The simple fact of intestinal obstruction presents little difficulty. The exact point of obstruction is extremely difficult to determine. A review of the clinical notes on this series shows that the tendency is to locate the lesion too low in the canal. The presence of bile in the stool or vomited matter may throw some light on the situation of the occlusion; too much weight, however, should not be placed on these findings, for Cordes has shown that an aberrant duct may open above or below the atresia. A late occlusion will show bile in the distal bowel, as a considerable number of cases testify. It is impossible to recognize multiple atresia; therefore the most that can be expected is a diagnosis of congenital occlusion.

PROGNOSIS

The prognosis of congenital atresia is absolutely bad unless the block is overcome. The average age at death is 6 days; there is a slight variation of the time depending on the location of the lesion, the age for duodenal atresia being 5 days and for the colon 8 days. Keith (1910) reported a case of duodenal atresia which lived 9 months; von Tischendorf (1887) and Theremin (1877) cases of occlusion of the lower ileum which lived 3 weeks; Gruneberg (1899) a block of the descending colon which died at 7 weeks. While this series shows only two cases of recovery through treatment we feel that in the future there should be a chance for a larger percentage of cures.

TREATMENT

Obviously surgery offers the only hope of cure, yet less than one-third of this series was subjected to laparotomy.

All cases reported to date, where an external enterostomy has been done as a temporizing measure, have resulted fatally. The most favorable case was that by von Tischendorf (1887) which was operated on on the seventh day and lived for 15 days.

Entero-anastomosis shows more favorable results. Fockens (1911) did an entero-anastomosis for atresia of the lower ileum on an 8-day child and Ernst (1916) did a duodeno-enterostomy for duodenal atresia on an 11-day old child, both cases recovered. Franke's (1898) case of entero-anastomosis functioned, but unfortunately a stitch broke and it died on the third day of peritonitis. In certain cases in which entero-anastomosis was practiced with unfavorable results it was discovered at autopsy that meconium had not penetrated into the contracted distal bowel. This fact has led Clogg (1904) to suggest that the contracted bowel should be distended by water pressure at the time of the operation. Of course the anastomosis should be the most favorable possible compatible with physiological and surgical principles.

From this series of cases and our single experience we are influenced to make the following suggestions.

Operation should be undertaken immediately following the diagnosis, provided, of course, that the infant is not suffering from some other condition which contra-indicates treatment for the atresia.

The anæsthetic to be employed is manifestly procaine infiltration. Spinal anæs-

thesia is not suitable nor is paravertebral justifiable, while ether, either by inhalation or by rectum, is distinctly contra-indicated.

The incision must be long enough to discover all occlusions for 15 per cent of these cases are multiple.

The operation to be performed is an entero-anastomosis either as a lateral or an atypical end-to-end union.

Undilatable and undeveloped distal bowel and widely scattered multiple occlusions are contra-indications to operation.

SUMMARY

Congenital occlusion may occur at any point in the intestinal canal. In 15 per cent of this series it is multiple.

The condition is relatively rare, it occurs once in about 20,000 infants.

There is no one cause for all of the cases. The various etiological factors may be summarized under the following heads: developmental anomalies; developmental accidents, fœtal diseases.

Prognosis is bad.

Treatment should be an entero-anastomosis performed as early as possible.

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PERFORATIONS OF THE ŒSOPHAGUS

Report of a Case of Transpleural Œsophageal Fistula

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A PATIENT has recently come under our observation in whom, following thoracotomy for pyopneumothorax, ingested food was discharged through the thoracic drainage opening. This œsophageal fistula, after persisting for one year, healed spontaneously. In placing this case on record, we have reviewed the various conditions in which the œsophagus has been found perforated into the mediastinum, air passages, or pleural cavity.

Lincoln, L., age 15, referred by Dr. R. W. Dawson, Redford, Michigan, to whom we are indebted for the pre-operative notes.

Family history is negative. There was a vague history of "quick consumption" in a great aunt 9 years before the birth of the patient. Both parents are alive and well. He is the youngest of five healthy children. The patient though always somewhat frail, had been well and of normal growth until his present illness. He had had measles at 10, chicken-pox at 11, whooping cough at 14, and paratyphoid fever of 1 month's duration at 14.

Present illness. On January 22, 1920, during the severe influenza epidemic, he came home from school complaining of a chill and feeling sick. He had been perfectly well the day before. On January 23, one day after the onset of the illness, there was a temperature of 104°, and soon signs of right-sided lobar pneumonia developed. For the first 5 days of the illness, he vomited continually, generally 5 or 10 minutes after taking food. The vomitus was often greenish (bile). It ceased abruptly on the fifth day. The temperature remained continuously high (103–104°) for a week, with respirations 30 to 34 per minute, and then the fever dropped to 100–101°, the respirations still remaining high (30 average). For the next month there was an evening temperature of 101–102°, but the patient seemed comfortable except for rapid respirations. The physical signs of consolidation in the right lower lobe persisted.

On about March 1, he began feeling a sense of fullness in the mid-sternal region on swallowing, and this became gradually worse. After a few days there was continual soreness in the mid-sternal region. He could drink liquids, but any solid food caused severe pressure-pain. The temperature, which had become normal for 2 days, rose to 103°.

On March 9, while eating breakfast, he suddenly vomited about a tablespoonful of foul pus, and became so asphyxiated that the mother thought he was dying. One half-hour later, he vomited a cupful of the same foul pus. This brought immediate relief. There was no further dysphagia, he was comfortable, and temperature became lower.

Dr. Hugo Freund saw the patient the next day. Breath sounds over the right lung were everywhere absent, and expansion was limited on that side. Succussion splash was heard in the right thoracic cavity on moving the patient quickly.

Patient was admitted to Harper Hospital, March 10, 1920.

X-ray on March 10, confirmed the diagnosis of pyopneumothorax. The fluid extended to the top of the fourth rib in front, and could be seen under the fluoroscope splashing in the partially air-filled thorax. The mediastinal contents were displaced to the left (Fig. 1).

Operation, March 11, Dr. Ballin. A three-inch incision was made in the right retro-axillary line, with removal of 2 inches of the right seventh rib. Foul smelling air escaped under pressure, together with some cloudy serum. For 3 or 4 days the discharge was very scant. Then the discharge became profuse and had an odor of butyric acid fermentation. Microscopic examination showed yeast cells and bacillus butyricus. Milk was suspected of being present in the discharge.

March 19, there was an odor of coffee to the discharge. Particles of food were noticed in the dressings, and after this, the amount of food in the discharge steadily increased.

March 21, X-ray and fluoroscopic examination showed a defect in the œsophagus, at the level of the fourth dorsal vertebra, through which part of the barium flowed. It then trickled along the margin of the collapsed right lung, to the vicinity of the drainage tube (Fig. 2).

High temperature, 103 to 104°; pulse, 100 to 104 persisted for several weeks. The food discharge was so alarming that starvation threatened. Gastrostomy was considered, but a Rehfuss tube was introduced and the patient fed entirely through it for 3 weeks.

May 9, he was discharged from the hospital. There was moderate drainage, still containing some food particles. He had gained weight and felt comfortable. Temperature, still present, had fluctuated irregularly since operation about 101, pulse 120. X-ray now showed some dilatation of the œsophagus at the site of the lesion. Less of the barium escaped via the perforation.

Subsequent history. Temperature continued until the middle of June, i.e., for 6 months after onset of

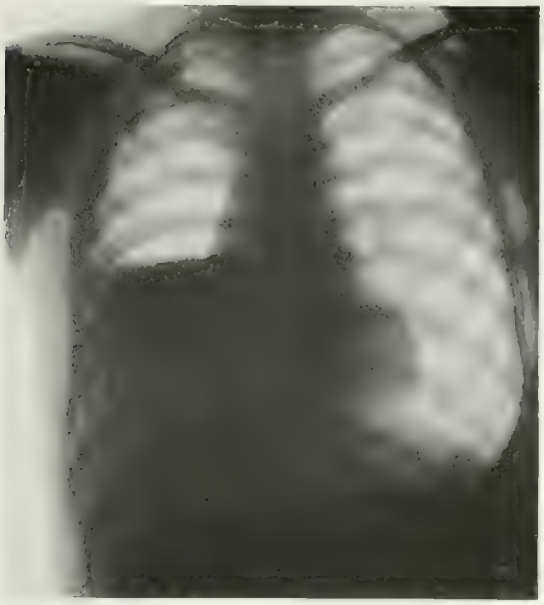

Fig. 1. March 10, 1920, right pyopneumothorax (before operation). Developed during a pneumonia of 6 weeks' duration. Dysphagia and sudden vomiting of a large amount of pus preceded the pneumothorax.

Fig. 2. March 21, 1921. Taken 10 days after thoracotomy. Shows escape of bismuth from œsophagus—transpleura—along the collapsed lung, collecting in right costodiaphragmatic angle and escaping through the drainage tube.

illness. It was 100–101° in the evening, normal in the morning. X-ray on May 21, showed a very small quantity of barium escaping through the fistula.

July 7, only thin fluid barium escaped via the perforation, and then only when large gulps were swallowed. With small quantities, or a thick mixture, there was no leakage. There was dilatation above the perforation, and also pronounced cardiospasm—barium was retained in the œsophagus several minutes. At this time there was noted some expansion of the upper portion of the right lung.

When seen on August 12, there was moderate discharge, which was frequently coffee-stained, or contained other ingested liquids. Patient was pale, with rapid respirations, but was improving in strength and gaining in weight.

X-ray November 16, showed a very slight trickle of barium into the pleural cavity. There was pouching of the œsophagus to the right (Fig. 3).

Shortly thereafter the boy was taken to Asheville, North Carolina.

December 25, 1920, drainage had decreased to a very scant amount of thick, mucoid, odorless material.

X-ray February 5, 1921, showed the lung considerably expanded, now filling two-thirds of the thorax. There had been practically no discharge for 3 or 4 weeks and the tube was removed (February 8, 1921, Fig. 4).

March 10, 1921, a letter from the attending physician (Dr. M. C. Millender, Asheville, North Carolina) and the mother stated that the patient was well, robust, and could climb thousand-foot mountains without fatigue or shortness of breath. He had gained 35 pounds since leaving the Hospital 1 year ago. The wound remained firmly healed.

CLASSIFICATION OF ŒSOPHAGEAL PERFORATIONS

Perforations of the œsophagus have been reported as due to the following lesions:

A. Congenital malformations
B. Neoplasms
C. Aneurisms
D. Trauma
   1. Œsophageal instrumentation
   2. Surgical wounds
   3. Stab and gunshot wounds
   4. Foreign bodies
E. Spontaneous rupture
F. Inflammation
   1. Acute œsophagitis
   2. Diverticula
   3. Simple or peptic ulcer
   4. Luetic ulcer
   5. Tuberculosis

In some of these processes the perforation starts from within the œsophagus (foreign bodies, ulcer, spontaneous rupture, carcinoma).

In others (stab wounds, abscesses, tuberculous mediastinal glands and aneurisms), a pathological process in the neighborhood of the œsophagus breaks into it.

DEVELOPMENT OF ŒSOPHAGEAL FISTULÆ

If the perforation is to the immediate exterior in the cervical region (following stab wounds, œsophagotomy, removal of pulsion diverticula), an œsophagocutaneous fistula results.

If the perforation is into the aorta or auricle (aneurism), it is immediately fatal.

If into the respiratory tract, there will ensue either an œsophagotracheal, œsophagobronchial, or œsophagopulmonary fistula.

If directly into the pleural cavity, a pyopneumothorax develops. Should this break through the thoracic wall or drainage be established surgically, there will be formed a fistula for which we propose the term transpleural œsophageal fistula, i.e., a communication between the œsophagus and skin via the pleural cavity.

A. Congenital atresia of the œsophagus. There are many cases of atresia of the œsophagus on record (1). The œsophagus and trachea are represented by a single tube until the second month of intra-uterine life. Occasionally the mid-portion of the gullet fails to develop; the pharynx leads down a short distance into a blind pouch; then follows a hiatus where no œsophagus can be demonstrated (or it is represented by a fibrous cord). In 60 to 70 per cent of cases, the lower portion of the œsophagus then begins with an opening into the trachea just above the bifurcation.[1] Shortly after birth, it is noticed that the baby cannot swallow, and on attempting to pass a catheter into the stomach, the tube will pass only a short distance down the œsophagus. X-ray shows the barium mixture outlining the blind upper pouch. The child dies during the first 2 weeks of life of aspiration bronchopneumonia. The tracheal fistula is quite constantly situated at or a short distance above the bifurcation, opening into the posterior tracheal wall (very rarely into a bronchus). The upper pouch extends 1 to 5 centimeters below the larynx. (Fig. 4 schematic—from postmortem specimens of two recent cases at Harper Hospital.)

Where there is no fistula, the conditions found include: localized stricture, atresia of the lower portion of the œsophagus, complete absence of that organ, or double œsophagus.

Gastrostomies are ill advised. If not immediately fatal, feeding through the gastric fistula will cause some vomiting and regurgitation up the œsophagus into the trachea (in the event that a fistula is present) leading to suffocation or aspiration bronchopneumonia. Richter (2) has attempted closure of the lower œsophagus in two cases by intrathoracic approach.

The common embryological origin of trachea and œsophagus may conceivably leave a potential fistula which will cause symptoms only later in life. Thus Zuppinger (3) quotes a case where a 24-year-old man was operated upon (how was not stated) for stenosis of the œsophagus. A fistula was found at the level of the sixth cervical vertebra, the size of half a pea, which Zuppinger explained upon the above hypothesis.

B. Neoplasms. Carcinoma of the œsophagus accounts for the majority of œsophageal perforations. The most frequent site of carcinoma of the œsophagus is the middle third of that organ—opposite the left bronchus. Clinically, the patient after 2, 3, or 6 months' increasing difficulty in swallowing, suddenly coughs up some bloody mucus, and then notices that swallowing the smallest quantity of liquid produces a very violent coughing fit, with the bringing up of the ingested liquid mixed with frothy mucus. Usually death results from aspiration pneumonia in 2 or 3 weeks.

C. Aneurisms. Several cases are known where fatal hæmorrhage was caused by an aneurism rupturing into the œsophagus. The rupture is usually preceded by ulcera-

[1] Brenneman (1) states that all the more recent and more exact reports show an œsophageal-tracheal fistula, but Hirsch has just reported a case where there apparently was no such communication—a probe passed up from the stomach into the œsophagus entered and ended in a blind pouch.

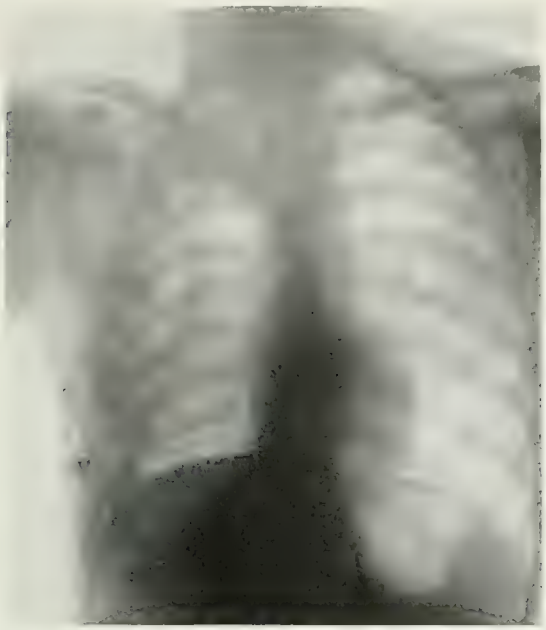

Fig. 3. September 1, 1920. Barium escape diminished. Lung somewhat expanded.

Fig. 4. February 12, 1921. Eleven months after operation. The fistula has closed. A trace of barium left in the intrathoracic scar still outlines the tract of the transpleural fistula. Right lung now fills two-thirds of right thoracic cavity, and is surmounted by a closed pneumothorax.

tion, sometimes gangrene, so that carcinoma of the œsophagus may be suspected.

Two cases have been reported (4) in which an aneurism caused death in the following manner. A small sacculated aneurism at the junction of the transverse and descending aorta, by continued expansile pressure against the posterior wall of the œsophagus, where it crosses the left bronchus, ulcerated a communication between bronchus and œsophagus. Death resulted from aspiration pneumonia without the aneurism itself showing any tendency toward rupture.

A valuable lesson regarding the use of the stomach tube in aneurisms may be drawn from an experience of the late Dr. Donald McLean, often related by him. After a previous visit, he returned to the home of a patient with a stomach tube, to examine him for difficulty in swallowing. On arrival he found that the patient had just died from a hæmorrhage through the mouth. Autopsy showed an aneurism which had perforated into the œsophagus.

D. Trauma. Perforation during dilatation for cardiospasm (5) or by the injudicious use of stomach tube or œsophagoscope are on record. Surgical wounds, stab or gunshot wounds can perforate the œsophagus, forming a fistula between œsophagus and trachea; or, as mentioned above, a fistula between œsophagus and skin. Foreign bodies may ulcerate from the œsophagus into the trachea, sometimes within 48 hours (6). Œsophageal fistulæ in the cervical region have become rarer since œsophagotomy for foreign bodies has been supplanted by extraction through the œsophagoscope.

E. Spontaneous rupture. Several cases are on record, where the œsophagus apparently ruptured spontaneously (Cohn 7). Many of these cases have had a pronounced alcoholic history. There is bloody vomiting, epigastric pain, a feeling "as if something broke inside," and then immediate collapse with dyspnœa and cyanosis. There is frequently mediastinal emphysema. Death results in a few hours. Postmortem shows a longitudinal rip 2 or 3 centimeters long in the cardiac portion of the œsophagus.

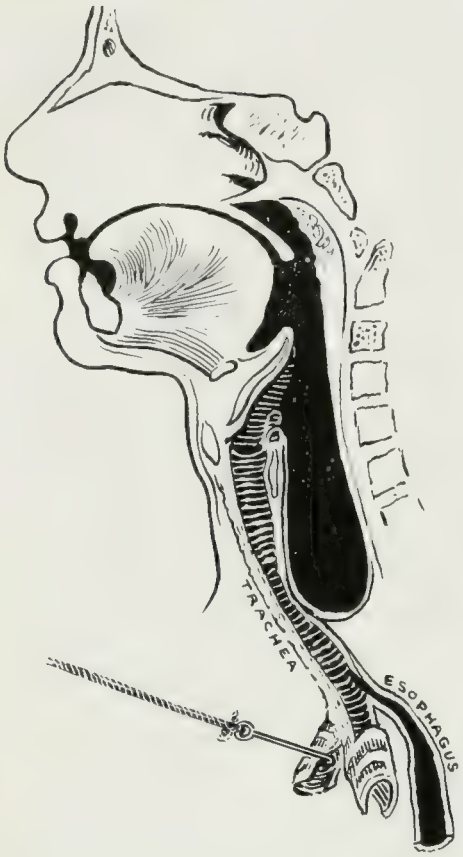

Fig. 5. Congenital atresia of œsophagus. Upper end of œsophagus ends in a blind pouch. Lower end communicates with trachea.

F. Inflammation. (1) *Acute gangrenous stomatitis* may extend down the œsophagus and cause perforation (3).

2. *Traction diverticula* develop following the scar contraction of a lymph node or inflammatory tissue in the region of the tracheal bifurcation. They are mentioned in the literature as liable to perforation, though because of their minute size, and the fact that they rarely produce symptoms, they are probably not of much significance (Judd 8, McCrae 9).[1]

3. *Peptic ulcer.* Two per cent of gastric ulcers occur in the cardiac portion of the stomach. The same type of ulcer has been observed in the lower end of the œsophagus. Kappis (10) collected 15 undoubted cases in 1910. Two-thirds of these had symptoms indicative only of gastric disturbances (pain, vomiting, and hæmorrhage), so that it was impossible to diagnose disease of the œsophagus antemortem. Severe hæmorrhage was an outstanding feature. Four of the 15 cases perforated; 2 into the abdominal cavity, causing death from peritonitis, 1 into the aorta, 1 into the right pleural cavity.

Christie (11) reported the following œsophageal peptic ulcer which perforated into the left thoracic cavity, with confusing signs of ruptured gastric ulcer.

The patient was a male, age 60, who had previously enjoyed perfect health. At 8.30 p.m., a short while after drinking a few glasses of beer, he was suddenly seized with violent pain and vomiting. When seen the next day, he had marked tenderness in the epigastrium and an area of dullness at the left base posteriorly. He was most comfortable when sitting upright in bed. A perforated gastric ulcer was diagnosed, and an exploratory laparotomy performed. The abdominal findings were negative. He died 3 hours after the operation with extreme dyspnœa. Postmortem examination revealed a large left hydrothorax, and a perforation of the œsophagus into the left pleural cavity 2 inches above the diaphragm. The opening was the size of a quarter. It was a simple ulcer with thinned out edges.

One œsophageal perforation was thought to be due to typhoid (12).

4. *Syphilis.* Syphilitic ulceration of the œsophagus is extremely uncommon. Udo Wile (13) was able to collect only a few cases in 1914, but he thinks the condition is probably not as rare as the literature would show. Œsophageal lues is known only as a tertiary sore, a gumma of the submucosa. This may either involute by fatty changes and thereby heal, or there may be early ulceration. Ulceration generally leads to scar contraction and stenosis. It may, however, perforate, as indicated in the following cases.

Schutze (14) reported a case of a woman, age 42, who had had frequent bone abscesses as a child, and had had six miscarriages. By being very careful, she could swallow a very small quantity of water without violently coughing. Postmortem, there was found an ulcer leading into the trachea from the œsophagus, "probably luetic."

[1] Since this article has gone to press, Hawes (31) has reported a case where such a diverticulum gave rise to symptoms and signs of chronic pulmonary tuberculosis with small cavity formation, and repeated hæmorrhages. The patient had observed for many years that "after eating certain foods, such as oranges, the sputum after coughing would contain particles of the above-mentioned foods. She also had coughed up tablets or pills 12 hours after she had taken them, with merely the outside coating gone." The diverticulum was outlined by ingested barium.

Basch (15) reported a case in which death took place 24 hours after intravenous salvarsan, given for nasopharyngeal gummata. The death was found due to a perforated gumma of the œsophagus, which had been unsuspected, and which lead into a patch of lung gangrene.

Dufour (16) reported a case of "extensive ulceration of the trachea below the ring cartilages, with a perforation in the center. No tuberculosis, probably luetic." Female, age 38, Wassermann—positive.

Levy (17) reported a case of a woman, age 24, who died of an œsophagotracheal fistula. No Wassermann was made, but from the microscopic picture (submucus round-cell infiltration and absence of other lesions), he concluded the ulcer was "probably luetic." He cites many other reported cases.

Beeler's patient (18) was a man, age 58, who had had lues 40 years before. Following 6 months' difficulty in swallowing, he suddenly had a hæmorrhage of bright red blood, followed by the usual coughing fit after deglutition. The patient died apparently of bronchopneumonia. Wassermann—positive. No postmortem.

5. *Tuberculosis.* A thick cluster of tuberculous glands in the neighborhood of the bifurcation of the trachea is very common. Their enlargement is almost a daily observation of the postmortem room. Zuppinger (3) collected most of the cases of non-traumatic œsophageal perforation in children reported up to 1903, and came to the conclusion that all non-traumatic œsophageal perforations in children were due directly or indirectly to tuberculosis. The retro-œsophageal lymph nodes may enlarge and produce a stenosis of the œsophagus, with or without breaking into it. This may be the explanation of a mild difficulty in swallowing in childhood which passes off without any demonstrable cause. The first bolus of food goes down with difficulty, the remainder more easily. Secondary rupture of the glands into the œsophagus takes place only after there has been extensive caseation with abscess formation. Often these cases are complicated by caries of the vertebræ.

The following types may be recognized.

a. Perforation from the caseous abscess into the œsophagus. The perforation may be first recognized at autopsy, or there may be more or less dysphagia, pain in the chest, relieved by vomiting of a large amount of material. Some of these children (all of the cases have been in children) survive the local condition and die of abdominal disseminated tuberculosis (3, 19, 20).

b. Perforation of the abscess into the œsophagus and trachea, by far the most common termination. There is a certain uniformity in the pathological descriptions; an abscess cavity in the mediastinum, communicating with œsophagus and trachea or bronchi.

"A round smooth opening of the anterior wall of the œsophagus led into an abscess cavity in the mediastinum, the size of a hen's egg, behind the end of the trachea and the two bronchi. There was an aperture in the right bronchus, one inch from the bifurcation, leading into this cavity" (21).

"Tuberculous, enlarged bronchial gland, necrotic, with an opening between the œsophagus and trachea the size of a finger" (11).

"There were many adhesions in the mid-wall of the left lung, near the aorta. There was a walnut-sized cavity, into the upper part of which two openings lead into the œsophagus. There was much tuberculosis in the left lung" (22).

"Œsophagus communicated with a cavity the size of a walnut, formed from a caseous gland. This cavity communicated with the right bronchus through a two-centimeter opening" (23).

Several of these cases have also shown advanced pulmonary tuberculosis. The lung gangrene may have been thought to follow aspiration of food through the œsophageal perforation (24), or the abscess may have been primary, the perforation of the œsophagus occurring after a few days of foul, putrid expectoration. The pathological sequence then was: advanced phthisis; gangrene with abscess formation at the hilus; perforation into the œsophagus. In Tirard's case (25), repeated chest aspirations were made searching for the abscess before the œsophagus perforated.

Most of the cases of this group have been between 5 and 20 years of age, but there has been an occasional case in advanced age.

Selenkow (26) reported a case of a man aged fifty, who died of œsophageal fistula following 3 or 4 months' difficulty in swallowing. This was thought to have been caused by a carcinoma of the œsophagus with perforation into the trachea. At autopsy, there was a well marked right upper lobe tuberculosis, and an egg-sized cavity in the mediastinum, into which the œsophagus opened.

Incidentally, the contrary mistake is also recorded. A man was treated in various hospitals and sana-

toria for 5 or 6 months for what was taken to be disseminated tuberculous bronchopneumonia. The physical signs, however, varied; at some times dullness, etc., was more marked than at others. X-rays showed varying shadows—at one time a relatively clear lung field was noted one week after a plate had shown many dense shadows. There was only slight difficulty in swallowing coming on 2 or 3 months after onset. At autopsy, a carcinoma of the œsophagus was found, with a small bronchial perforation. Just enough food escaped through this fistula to produce repeated bronchopneumonic patches which then would heal.

TRANSPLEURAL FISTULÆ OF THE ŒSOPHAGUS

Passing by the etiological factor, which in this group of cases cannot always be definitely stated, transpleural fistulæ of the œsophagus deserve special consideration on account of their therapeutic possibilities. This group comprises cases in which the œsophagus perforates into the pleural cavity without communicating with trachea, bronchus, or lungs. We have been able to find reports of only 6 such cases in the literature as follows:

Case 1. (Osler, 27.) Man, age 34. At 10 he developed a painful right-sided tumor above the nipple. At that time he expectorated considerable yellow material. The tumor would remain prominent several days, then disappear, during which latter time the patient would have pain in the breast, and profuse expectoration. This lasted 3 or 4 years. Then a fistula formed, which was still patent when examined (20 years later).

During a retention period, there was a fullness in the chest, he felt something give, and noticed a corn in the fistula opening. Since than he frequently observed food particles in the dressings. There was frequent slight hæmorrhage from the fistula.

Examination showed a thin emaciated man, with right side of his chest collapsed and right shoulder drooping. There was a fistula in the first right interspace, 3 centimeters from the sternoclavicular joint.

Two weeks later, the man returned. He was much worse, and there was a noticeable depression and tenderness of the first and second dorsal vertebræ. No further observation was recorded.

Case 2. (McLachlan, quoted by Osler.) A 25-year-old female, who had had severe pain in the right infraclavicular region for many years.

After several months' observation she developed what appeared to be an abscess in her right breast. This was incised, and a large quantity of pus discharged. Six months later the patient noticed food particles in the dressings. If she sat upright, and drank fluids, some came through the dressings.

Case 3. (Voelcker, 28.) A 6-year-old boy had empyema, a rib resection was done and then he discharged ingested fluid through the empyema wound for many months.

At autopsy, caries of the fifth and sixth ribs and fifth and sixth vertebræ, together with two perforations of the œsophagus at this level were found.

Case 4. (Martens, 29.) The patient had been under treatment for tuberculosis for 10 years. Seven years ago he had empyema, for which thoracotomy and drainage were performed. During convalescence an œsophageal fistula developed, the origin of which was held to be caseous bronchial glands. Retention made re-operation necessary. After the lapse of a year, the discharging fistula had healed twice, only to reopen. Another attempt to close the fistula failed.

Examination (1903, 7 years after onset of fistula) showed an opening in the right posterior thorax region 4.5 by 3.5 centimeters in diameter, through which a large intrathoracic cavity could be inspected. This was 8 centimeters in depth to the right, 7 centimeters deep to the left. Ten bronchial fistulæ were visible. In the upper posterior portion an œsophageal fistula could be seen alongside the large vessels. When he drank, a small amount of fluid issued from this œsophageal opening. He had been dressed every other day for 7 years, and 3 years ago had undergone a severe knee operation following an injury, with perfect healing. Tubercle bacilli had been present in the sputum in 1896, but not at this time. General condition was excellent.

Case 5. (Downes, 30.) Twenty-two-year-old male. In April a fluid tumor was aspirated from the right thoracic region, with discharge of fetid pus. Tuberculosis of the sternum was diagnosed. Two operations were performed, during which the sternum, and portions of the right second, third, and fourth ribs were removed. A sinus was seen in the mid-line, the end of which was not apparent. Four days after operation, an orange seed was noted in the discharge, and thereafter food particles appeared regularly in the dressings. In November a gastrostomy was done, and the patient fed himself through the tube for a year, gaining 40 pounds. (This is the only œsophageal fistula which has been benefited by gastrostomy.) Then he could take nourishment through the month, though occasionlly some food would come through the thoracic fistula. No subsequent record.

Case 6. (John, quoted by Downes, 30, but the reference could not be found.) It was of a child with an abscess of the thorax, through which food came. A gastrostomy was necessary. The child died of tuberculous peritonitis.

To these six reports we wish to add our case.

Case 7. (detailed above). Summary. Boy, age fifteen. Clinical signs of right unresolved lobar pneumonia persisted 6 weeks. Following a few days' difficulty in swallowing, a large quantity of putrid material was vomited. The next day a right pyopneumothorax was present. A few days

after thoracotomy, food was noticed in the discharge. Temperature persisted for months. The discharge through the œsophageal fistula gradually decreased. The tube was removed 1 year after operation, and healing ensued.

These seven transpleural fistulæ differ from all other recorded cases in that the patients enjoyed life in relative comfort for a long while after the œsophagus had perforated: Case 1, 24 years, Case 4, 7 years. The fistula developed following some isolated suppuration in the chest, either encapsulated postpneumonic empyema or tuberculous mediastinal glands. Clinically two courses can be distinguished: (1) The abscess breaks abruptly into the œsophagus, pus is vomited, secondary infection of the abscess by food particles follows, the process extends to the pleural cavity and very shortly a well-developed pyopneumothorax is apparent. On draining this, food particles appear in the discharge (Cases 3, 4, 7). These steps could be clearly distinguished in our case. (2) The perforation is slower and becomes walled off from the pleural cavity. A spontaneous thoracic fistula develops, which is found to communicate with the œsophagus (Cases 1, 2, 5). Perhaps the first are postpneumonic, the second tuberculous in etiology.

Osler mentions perforation of the œsophagus as a complication of empyema, referring to Cases 1, 2, and 3 above. In his case, he gave no more definite diagnosis.

Zuppinger, as already stated, working in a pediatric clinic, came to the conclusion that all non-traumatic perforations of the œsophagus in children were of tuberculous pathogenesis. The process generally started from caseous bronchial lymph glands, and he mentioned caries of the vertebræ as a frequent complication.

Very acute perforation of a primary œsophageal ulcer into the pleural cavity (Kappis, 10) is quickly fatal. The symptoms are similar to those of a perforated gastric ulcer —abdominal and diaphragmatic rigidity— plus respiratory distress. This type may be more frequent than is generally believed. If the thorax will withstand the infection, and the patient withstand the shock for a short while, the clinical characteristics seen in our case will develop, and the case be available for treatment by thoracotomy.

Difficulty in swallowing, vomiting of pus, followed by rapid development of a pyopneumothorax are suggestive of perforation of the œsophagus. An early roentgenogram showing the barium mixture escaping from the œsophagus into the thorax may in some instances be obtained.

After thoracotomy, a rancid odor of the discharge and the escape of food will render certain the diagnosis. Of course, early and free thoracotomy gives the best prognosis.

In no case previously reported has the fistula closed.[1] Case 4 was observed for 7 years; Case 1 24 years; Case 5, 1 year. In our case, after the fistula remained open 1 year, it closed spontaneously.

Gastrostomy may be indicated if the food discharge threatens to lead to starvation. In our case feeding through a Rehfuss tube left *in situ* for 3 weeks brought the patient safely over the period of threatened starvation, and it also contributed markedly toward diminution of the leakage of food.

Operations for closure of a transpleural fistula of the œsophagus have not been attempted, so far as we know. Perhaps from the happy result in our case the lesson of long-continued conservative treatment, after proper drainage through a thoracotomy has been established, may be drawn.

[1] Hawes (11), in the article above referred to, also reports a case of œsophageal fistula complicating a lung abscess. In this case the perforation had first taken place between the œsophagus and the lung abscess. The abscess was then opened by rib resection, and food was discharged from the wound. The fistula closed in about three months.

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PSEUDOHERMAPHRODITISMUS MASCULINUS INTERNUS

Congenital Malformation in Scrotum—Two Testes and Uterus in Right Portion of Scrotum[1]

By DAVID W. MacKENZIE, M.D., F.A.C.S., Montreal
From Department of Urology, Royal Victoria Hospital, Montreal

MALE; age 38; single; admitted May 27, 1918; occupation, factory hand. Patient complains of rupture, pain, and mass in right groin. He thinks he has had a mass as long as he can remember but that it has been more pronounced for the past 25 years; during the last 4 days, it has increased in size and has become painful.

Diagnosis. Congenital mal-descent of testis with uterus in the right portion of the scrotum.

History. Since the age of 5 or 6 years he has had a swelling in the right groin; he thinks this followed a kick. The swelling has appeared and disappeared at intervals during the past 32 years. Last winter, it was much smaller for several months without the use of a truss, which he has worn most of the time as long as he can remember.

Last week he had a vomiting attack accompanied by headache. A few days later, 4 days ago, the swelling in the groin increased and extended to the scrotum. There was considerable pain, which has persisted. He has had no vomiting for 4 days.

Past history. Patient had scarlet fever in childhood. Several times he has had headache and vomiting which lasted one or two days. He does not smoke or drink. Two years ago he had a gonorrhœal urethritis of which he has never been completely cured. There is no history of lues.

Physical examination. He is a well-developed, well-nourished man in no apparent pain or distress. The skin and mucous membranes are of good color. The left axilla has a palpable gland; otherwise normal. The chest is well formed; the expansion is good and equal; the vocal fremitus is normal; percussion is normal, lung is resonant throughout; auscultation is normal. The pulse rate is 70, regular and of good volume and tension; the vessel wall is just palpable; the heart has a normal beat, it has no murmurs. The upper teeth are false, the lower poorly kept. The tongue is clean; the abdomen moves freely on respiration; it is equal and symmetrical. Deep and superficial reflexes are present; there are no pathological reflexes. There is no costolumbar tenderness; there is no pain or tenderness along the ureters or over bladder. The right side of scrotum is greatly enlarged; there is no tenderness. There appear to be two round masses, with an irregular mass in the center, which extends well up into the inguinal canal, where there is a marked impulse on coughing; this scrotal mass does not transmit light. The left scrotum is small and no testis is present. No perineal dimpling. The prostate is normal in size, contour, and consistency; in the region of the right seminal vesicle there is an elongated mass which extends up as far as the finger can reach; the left seminal vesicle is small and firm. The urine is clear, dark amber, acid, 1019, no albumin or sugar. Microscopic examination shows no pus, but many urates. The Wassermann is negative.

Operation, May 30, 1918, for congenital dual testes in right scrotum with congenital hernia, by Dr. MacKenzie; ether by Dr. Grant. Through a right inguinal incision, the inguinal canal was opened. The cord was found large, hard, and continuous to scrotum; the hernial sac identified, freed, ligated at neck, and resected.

The mass consisted of two moderately sized testes in right scrotum with a large mass between, which extends up the canal and down the course of the vas (Fig. 1). One testis was freed, placed in warm gauze with its pampiniform plexus and vas intact. The other testis with oblong mass attached was freed well into pelvis, ligated here, severed with cautery and removed *en masse.* The first testis was replaced in scrotum and wound closed by Bassini method.

Convalescence uneventful. May 25, 1920, active spermatozoa were found in seminal fluid.

REPORT ON SPECIMEN

Mass from right side of scrotum. The specimen received, removed from the right scrotal sac, consists of a well-formed testicle of normal size and apparently intact tubules. Quite closely attached to it is an elongated, pear-shaped organ measuring 9.5 by 4 centimeters, with a central canal, which on being opened presents a well-formed mucous membrane, supported by a thick muscular wall. This organ-like structure (uterus) lies below the testicle in the scrotum, the larger end being dependent. It conforms in general with the appearance of a juvenile uterus, being narrow and possessing a long cervical end. To the left lower aspect a well-formed fallopian tube 6 centimeters in length is attached. This tube shows a rudimentary fimbriated extremity and a small pedunculated cyst, which apparently corresponds to a cyst of Morgagni. A well-marked epididymis can be made out on the posterior surface of the testicle and from this a tortuous tube (vas) runs up on the posterior surface of uterus and toward its upper extremity becomes embedded in its posterior wall, but the cross section shows a well-marked lumen. Surrounding this cord, and embedded in the con

[1] Read at Urological Society, New York Academy of Medicine, April 27, 1921.

nective tissue are a number of smaller cord like structures, some of which have a very definite lumen; others appear obliterated. Running along the left margin of the uterus is another quite thick cord-like structure, which takes origin near the isthmus of the fallopian tube and becomes embedded toward the upper end in the wall of the uterus. The upper end on section shows only a minute central lumen, while toward its other end it is apparently convoluted and on cross section shows three lumina from which can be pressed a whitish fluid.

Sections from what appears to be a uterus show a mucous membrane which is lined by a surface columnar epithelium and consists of a very cellular stroma, the cells of which resemble very closely those of a normal uterine mucosa. Embedded in this are a number of tubular glands, which, although rather irregularly arranged, tortuous and small, are lined by a single layer of high columnar epithelium. The mucosa is supported by a rather vascular, but quite typical muscularis. Diagnosis: abbreviated and juvenile uterus.

Sections from the fallopian tube show a well-formed and definite structure consisting of folds and projections of mucosa, which are lined by a simple columnar epithelium and which surround a lumen. This mucosa is supported by a muscular layer and covered by a serosa, which shows marked œdema. Quite closely attached to the tube and included in the same section are numerous cross sections of tubules, which resemble very closely those of an epididymis. Diagnosis: fallopian tube and tissue from epididymis.

Section from the testicle consisted of testicular tubules which are evidently actively functionating, as many spermatozoa can be demonstrated.

Sections from the cord-like structure in the posterior aspect of the uterus show a very thick walled muscular tube with a small lumen in which lie a number of papillary projections lined by stratified columnar epithelium. Diagnosis: vas deferens.

Another section taken from somewhat similar structure lying along the lower wall of uterus shows a similar but much smaller vas deferens.

Sections from the rather soft elongated mass which lay near the fallopian tube and which was thought possibly to be ovarian tissue, show the mass to be made up of cross sections of tubules resembling those of epididymis; therefore, probably epididymis.

These findings in a man who presented all the masculine anatomophysiological characteristics in addition to a uterus and a fallopian tube, led me to look up the literature, where I found 26 very similar cases with several more of the same embryological genesis. They all have strong masculine characteristics, although a few are hypospadias or pseudo-feminine. Only a small portion of these men had children, as those reported by Braithwaite, Craig, and Brindeau. In one-quarter of the cases the uterus was double; when single it was usually atrophied. The testicles were normal in only a very few cases; they were generally atrophied and degenerated. The uterus continued into a vagina opening into the urethra, a fact which explains the escape of blood from the canal, as has been noted after the operation.

EMBRYOLOGICAL GENESIS

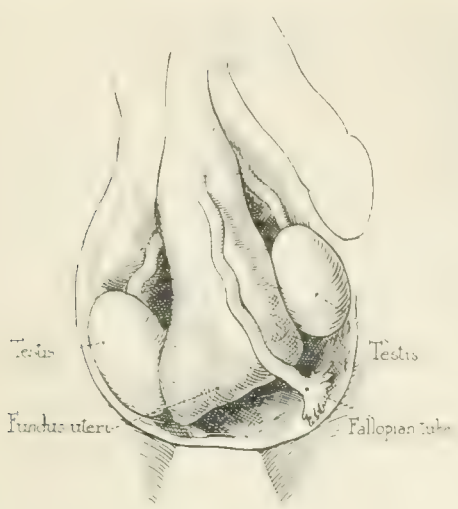
Hermaphroditism is divided into two groups:

1. Hermaphroditismus verus, in which an individual is truly bisexual and in possession of independent testicles and ovaries, or, at least, one ovary and one testicle. Recent investigations have made the existence of hermaphroditismus verus doubtful, as in the cases so far reported the histological evidence has been lacking or has been incomplete. A few cases of fused, so-called ovotestis, have been reported.

1. Pseudohermaphroditismus. This is divided into pseudohermophroditismus masculinus and pseudohermaphroditismus femininus, in which a predominant typical and complete sexual organization of one type is associated with an incomplete or complete set of sexual organs of the opposite sex, but without sex gland (ovary or testicle). It may, therefore, be subdivided into: (1) pseudohermaphroditismus internus in which the internal organs of the opposite sex exist. (2) pseudohermaphroditismus externus in which the external organs of the opposite sex exist, and (3) pseudohermaphroditismus completus in which both are present. Pseudohermaphroditismus masculinus is the most frequent. Up to 1908 Neugebauer collected altogether 910 cases of pseudohermaphroditism and in these 722 were of the masculine variety, and only 188 of the feminine variety, while 613 of the whole series were examples of pseudohermaphroditismus masculinus externus (see Birnbaum, A clinical manual of malformations, etc., translated by Blacker, MacMillan Co. 1912). It can again be subdivided into pseudohermaphroditismus masculinus internus and externus. In the internus are present, besides well-developed, typical, external and internal male genitals, vagina, uterus and tubes which usually terminate in the situation of the colliculus seminalis. The case recorded above belongs to this category.

In the pseudohermaphroditismus externus the external parts of the female type are present.

All cases of hermaphroditism are intelligible on the basis of the embryological sexual development. For in the early fœtal life, during the period of mesonephric development, the human organism is bisexual or possesses, at least, all the



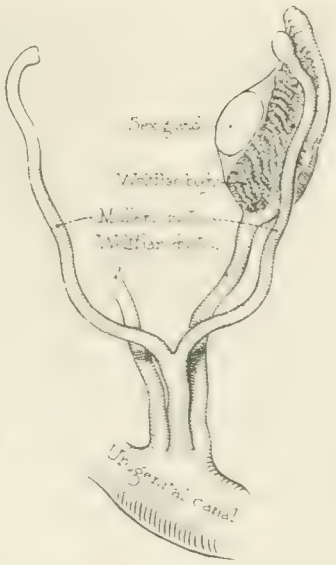


Fig. 1 (at left). Schematic view of condition as found at operation.
Fig. 2. Schematic view of embryogenesis of muellerian and wolffian ducts.

tructures necessary for the development of both sexes. At this time there develops a ridge along the border of either mesonephros. This gives rise to Mueller's duct, a cord-like structure which later forms a tube. On either side, this lies internal to the wolffian duct (primitive ureter) and terminates with the wolffian duct into the urogenital sinus. As the sexes differentiate, the fate of these structures is dictated by (1) the development of the sex gland (ovary or testis) which develops from the genital tubercle of the mesonephros. The latter then disintegrates, leaving only a small part which in the male goes to form epididymis, seminal vesicles, coni vasculosi, vasa efferentia and ejaculatory duct; while in the female it forms the paroophoron; the duct of Gartner and the parovarium. (2) The fate of Mueller's ducts. As the male development proceeds, these involute as early as the seventh to the eighth week. Only rudiments remain as the utriculus masculinus (prostatic sinus) and hydatid of the epididymis. In the female, however, Mueller's ducts continue to develop and to reach the height of development in fusion, anteriorly to form the tubes, posteriorly, to form uterus and vagina. Pseudohermaphroditismus masculinus means, therefore, embryologically considered, persistence and more or less complete or, as in this case, partial, rudimentary or infantile development of the muellerian ducts to uterus, tubes, and vagina which terminate in the normal prostatic sinus. The cause of this lack of involution, but persistence and development of the muellerian ducts in these cases is not known. It is possibly connected with lack of proper determination of sex characters (hormone action). In favor of this is the occasional co-existence of other physical and mental female characters. These secondary characters were lacking in this case. The individual was apparently a full male. But here also the female organs were underdeveloped, infantile in type, as in Webster's case.

Interesting is the peculiar rotation that occured in the hernial descent to the scrotum, so that the fundus which originally points upward in the abdomen occupies the lower position in the scrotum.

The literature on pseudohermaphroditism has been reviewed by Neugebauer (1). Since then the following cases have been reported of which Webster's case is nearest to the one described above.

Clark tells of patient of normal male appearance, 30 years old. He had been married 6 years but he had no children. An operation for hernia on the left side drew from the abdomen a normal testis, uterus, and tubes. There was no testis in the scrotum.

Brindeau's patient was a soldier 35 years old. He was married and was the father of two children. An operation for a right scrotal hernia revealed a mass containing a normal uterus with right tube

and also a testicle with vas. The left horn of the uterus had another tube within the abdomen and when drawn upon it brought down a second testicle of normal appearance, with vas.

Braithwaite and Craig report a left hernial operation on a boy 14 years of age. Traction in the hernial sac revealed in the end the internal organs of generation of a female with the exception that the positions usually occupied by the ovaries were filled with atrophied testes.

Pellegrini reports a case in which a uterus with both tubes, together with two testicles, was found in the right hernial sac of a child 26 months old with normally developed male genitals.

Fantino reports the finding during an operation for a right-sided hernia on a boy 18 years old of both a uterus with tube and a testis, arranged from below upward as right testicle, uterus and tube, left testicle.

Viscontini reports having found on a well-developed man 22 years old, during an operation for hernia, a mass containing a uterus with left tube. The scrotum contained two normal testicles, on the right and the left sides.

Duse reports an operation for a right-sided hernia on a man 20 years of age. Both testes were situated in the right side of the scrotal sac. In following the vasa to the abdominal cavity a unicornate uterus of infantile type was found.

Webster reports on a specimen sent to him while he was surgeon in our own hospital. This specimen is almost identical with our own case above.

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SARCOMA OF THE PROSTATE[1]

By WILLIAM WARREN TOWNSEND, M.D., F.A.C.S., Burlington, Vermont

WE report the following case with a digest of the literature on sarcoma of the prostate in the adult, first, because of the comparatively few reports to be found in the literature, and second, that in so far as we have been able to ascertain there has been no case reported in a man of the advanced age of our patient.

W. H. C., age 71, was referred, October 31, 1919. His chief complaints were that of dysuria and frequency accompanied by symptoms of urinary obstruction. He had been losing flesh for about 6 months and had periodic attacks of gastro-intestinal disturbance. Reference of Mr. C. to the gastro-enterologist and the neurologist failed to lead to the discovery of any gastro-intestinal or nervous pathology that could be ascribed as the cause of the emaciation or the gastro-intestinal symptoms. Blood examination and Wassermann test were negative. Urological examination showed by rectal palpation an enlarged and soft prostate. The urethral length was increased to 25 centimeters. No obstruction was met in passing a No. 20 French soft rubber catheter. There was 120 cubic centimeters residuum and the bladder capacity was 200 cubic centimeters. Cystoscopic examination showed a large uniform intravesical prostatic outgrowth, a generalized cystitis and trabeculation. The ureter openings were not seen and as the examination was painful no prolonged attempt was made to find them. Personal circumstances prevented an immediate hospital admission for prostatectomy, so palliative treatment was instituted until he entered the hospital on January 23, 1920. Within 24 hours after admission to the hospital Mr. C. developed a pneumonia which further delayed operation. On February 14, an attempt at suprapubic prostatectomy was made. Upon introducing the finger into the urethra to start enucleation, it was obvious that something different from the ordinary was being encountered as there was no line of cleavage and the substance of the growth was so friable that it had to be removed as best we could with a gall-bladder scoop and flushing. Enough pieces were gathered to send to the laboratory, and the following report from the pathologist is presented.

"Report of examination of several small fragments of whitish friable tissue, case of Mr. C., the largest about 4 millimeters in diameter. The larger fragments were composed of closely packed, small, round, mononuclear cells with an occasional cell of large size with more cytoplasm, with very small amount of connective tissue scattered through the growth in small fibers and short trabecular-like masses showing no definite arrangement. Some of these masses were partly surrounded with loosely formed connective-tissue walls infiltrated with the round cells. Poorly outlined blood vessels appeared in the growth and a few atrophied gland tubules were visible in some of the fragments. The specimens presented the characteristic structure of round cell sarcoma."

Mr. C.'s convalescence from operation was uneventful. His suprapubic wound closed and normal urination became established in 3 weeks. He was discharged from the hospital, March 10, 1920. By the "follow up" his physician advises me that "while Mr. C. has no urinary symptoms and no evidence of trouble with the wound, his general condition is not good." We will continue a "follow up" on the case and report the ultimate result at some future date.

A sarcoma of the prostate may start primarily or may transplant itself from the testicle or elsewhere. The small round-celled form appears to be the most frequent. H. A. Royster's (1) statement that they often result from injury has been challenged by Schepelmann (2) who lays down the dictum that "there is no possibility of a neoplasm having been caused by injury, if the interval between the accident and the development of the tumor is more than 3 or 4 weeks."

One of the earlier, seemingly well-authenticated cases has been recorded by Coupland (3): a man, aged 29, with a "lymphosarcoma." However, J. Ewing (4) doubts the diagnosis of lymphosarcoma, as the structure of the gland does not favor the growth of such tumors.

Wharton (5) has put on record the case of a man, aged 55, with retention of urine. The patient died on the ninth day after operation. Postmortem revealed a round-celled sarcoma of the prostate.

A case quite similar to that of Wharton has been reported as early as 1873, by Socin (6), regarding a man, aged 51, who died of septicæmia, 5 weeks after catheterization.

West (7) reports the case of a man, aged 21, with difficult micturition. The disease took a rapid course. Autopsy showed a large tumor composed of small round spindle cells.

[1] Read at the meeting of the American Association of Genito-Urinary Surgeons, Rochester, Minnesota, June, 1920.

H. Hill (8) has seen the specimen from a man, aged 64, who had died suddenly after suppression of urine for 10 days. The growth consisted of an abundant stroma of fibrous tissue, containing many spindle cells.

C. L. Gibson (9) reported the case of a man, aged 35, who 4 months previously had been operated on; the portion removed was a small, round cell sarcoma of the prostate. However, the tumor grew rapidly and 4 months after the first operation rectal examination showed a mass the size of a fist occupying the prostatic region. Combined suprapubic and perineal operation was followed by death from exhaustion.

A second case reported by Gibson (10) was that of a man, aged 36, admitted for urinary trouble. An irregular mass replaced the prostate. The tumor grew very rapidly. The patient died of exhaustion. Microscopic examination showed a round cell sarcoma, moderately vascular. Gibson reported the above cases to this society in 1904 and 1909.

Charles E. Powers (11), in 1908, was consulted by a man, aged 60, for rapidly increasing difficulty in urination. Rectal examination revealed a very large, rounded, slightly nodular prostate. He succumbed on the fifth day after operation. Examination of the masses removed showed a small round-celled sarcoma of the prostate. In reviewing the literature, Powers considers this form as the most frequent, and the condition occurring most frequently in childhood.

Analyzing the cases tabulated by Powers (9) and Proust (12) and eliminating those in the latter's tabulation not accepted as authentic, up to the year 1907 we have 33 cases. To these must be added a case report by Cabot (13) regarding a man, aged 75, with a small spindle cell sarcoma; and a case described by Bobbeo (14). Moreover, Depage (15) successfully removed a prostate from a man, aged 25. Microscopic examination showed a small round cell sarcoma.

In 1909, J. R. Eastman (16) reported the case of a man, aged 27, with a spindle-celled sarcoma of the prostate apparently running a course covering 5 years. Eastman believes that sarcoma of the prostate is less rare than had been imagined, owing to the circumstance that until recently very little distinction had been made between carcinoma and sarcoma. Pouchet (17) reiterates the fact that sarcoma in adults is rare.

Newman (18) reports the case of a man, aged 35, with retention of urine following an injury. The entire prostate was found occupied by a growth which proved to be a round-celled sarcoma. One of the important features in this case was the primary existence of a small, well-encapsulated sarcoma of the prostate, which had given no symptoms before the injury to the perineum when the rupture permitted the rapid growth of the neoplasm.

The common symptoms, besides the presence of the tumor, are dysuria, retention, hypogastric and perineal pain. The treatment is symptomatic and palliative. J. F. Warbasse (19) urges enucleation. Others recommend radium treatment at the earliest moment. Pfahler (20) claims X-rays will cure the majority of cases. Deaver (21) calls attention to the rapid growth of sarcomata.

The *New York Medical Journal* (22), editorially dwelling on the malignancy of prostatic sarcoma, points out that as the neoplasm grows in the adult less rapidly than in children, operation offers more chance of success in the adult. Early diagnosis is important; in elderly subjects, disturbances of micturition and the appearance of a tumor in the hypogastrium and perineum leading to the phenomena of cachexia should cause suspicion.

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UTEROPLACENTAL APOPLEXY (HÆMORRHAGIC INFARCTION OF THE UTERUS) IN ACCIDENTAL HÆMORRHAGE

Report of a Case and Study of the Clinical and Pathological Data of Sixty-Eight Cases in the Literature[1]

By PRENTISS WILLSON, M.D., Washington

HISTORY

SINCE Rigby established the differentiation between antepartum hæmorrhage due to placenta prævia and that due to premature separation of the normally implanted placenta, the etiology of the latter condition continued practically unknown. Traumatism from without or from within through traction on an absolutely or relatively shortened cord, sudden reduction in the size of the uterus from the birth of a twin, or the emptying of the membranes of an excessive amount of amniotic fluid, inflammatory changes in the decidua, even violent emotion, were all, from time to time, advanced as etiological factors of significance. Later the association of albuminuria with a large percentage of these cases attracted attention, and the idea was advanced that the placental separation was determined by hæmorrhagic lesions in the decidua which were associated with the presence of a nephritis, usually chronic in character. As early as 1903, Muus of Copenhagen advanced the hypothesis that accidental hæmorrhage was a manifestation of a pregnancy toxæmia, and called attention to the frequent association of eclampsia with these cases.

To Couvelaire, however, undoubtedly belongs the distinction of having made the first really important contribution to this subject since that of Rigby, a contribution which has not only served to focus attention on accidental hæmorrhage and to blaze an approach to its study from an entirely new angle, but promises, possibly, to aid materially in the investigation of the whole broad subject of toxæmia in pregnancy. In 1911 in one case, and again in 1912 in two cases, he described in great detail the gross and histological findings in the uterine wall in accidental hæmorrhage. These consisted, in brief, of an extensive subserous ecchymosis and of a marked hæmorrhagic infiltration of the myometrium, tearing the muscle bundles apart and even disassociating them fiber from fiber. These lesions he believed to be toxic in character. It is true that prior to Couvelaire's first paper there were in the literature a few reports of similar changes in the uterine wall in cases of accidental hæmorrhage, but none of the authors seems to have been much impressed with the importance of his observation. Couvelaire's work immediately attracted attention in France and in Europe generally, and in 1913 Essen-Moeller contributed an important paper in which he reported five cases of this type. In concluding this paper he said:

"There are two genetically different forms of accidental hæmorrhage. The one is caused by trauma; the other is due to an intoxication of the same kind which causes albuminuria, eclampsism, or eclampsia. . . . The extensive bleedings in the uterus (*apoplexie utéro-placentaire*) observed by Couvelaire and other authors are probably characteristic of the eclamptic form of accidental hæmorrhage." In America these advances in our knowledge seem to have attracted no attention until Williams, in 1915, reported the findings in the uterine wall in two of his cases and reviewed the literature. The pathological picture noted by him was essentially the same as that described by Couvelaire, and he, also, concluded that the lesions present were toxic in origin. Since this date case reports and articles on this subject have been accumulating with increasing rapidity. Thus, Williams, in 1915, collected about 20 cases; Ahlström, in 1919, 43 cases; and Willson, in 1921, 69 cases.

NOMENCLATURE

Kolisko, 1903, designated this condition hæmorrhagic infarction of the uterus (*infarctus hæmorrhagicus uteri*). Couvelaire,

[1] Read before the Medical Society of the District of Columbia, April 27, 1921.

1911, suggested the term uteroplacental apoplexy (*apoplexie utéro-placentaire*). Williams, 1915, stated that neither of these terms seemed to describe the condition accurately but that he was not prepared to suggest a better one. FitzGibbon, 1918, proposed the term antepartum toxæmic hæmorrhage.

SCOPE OF PAPER

In this paper, in addition to reporting a case of my own, I wish to present an intensive study of the clinical and pathological data of all the cases in the literature to this date. It is hoped that the examination of these data, here brought together for the first time, will serve to give a composite picture of the condition sufficiently accurate and authoritative to justify drawing more or less definite conclusions regarding its etiology and pathogenesis; its relation to accidental hæmorrhage and the other toxæmias of pregnancy; and its diagnosis, prognosis, and treatment. In Table I the clinical data of 69 cases are assembled. The cases are arranged and numbered in the order of their publication. In Table II the pathological data of 46 cases observed at laparotomy or autopsy are assembled. The case numbers in this table correspond to those in Table I, the omitted cases being those in which there are no other pathological data reported except the presence of subserous ecchymosis and hæmorrhagic infiltration of the uterine wall.

REPORT OF A CASE

My own case is as follows:

N. D., age 37, illegitimately pregnant for the first time, was admitted to the Riggs Building of the Georgetown University Hospital at 3 a.m. November 9, 1915, from the Florence Crittenton Mission. The following history was obtained: She had been admitted to the Mission on September 17. Upon examination on the 19th, it was found that her family and previous history were negative. She had menstruated first at 14 years of age. The last period had begun on February 15, 1915. The date of impregnation and quickening were unknown. At this time the fundus was three fingers' breadths above the umbilicus. The presentation was transverse. The fœtal heart was heard in the right lower quadrant. The pelvic measurements were, bispinous, 24 centimeters; bicristal, 26.5 centimeters; bitrochanteric, 31 centimeters, and the external conjugate, 19 centimeters. The limbs were œdematous and the urine contained albumin. The blood pressure was not taken. Under appropriate treatment the œdema cleared up, the albumin disappeared from the urine and none was found at the examinations made during the last 3 weeks before labor. Full term was estimated for November 22, 1915.

Labor began at 9:30 on the evening of November 8, at the estimated thirty-eighth week of pregnancy. The pains were severe and every 4 or 5 minutes from the first. After lasting for about 2 hours there began to be some bleeding from the vagina and the patient was nauseated and vomited at frequent intervals. She complained of great pain and tenderness in the abdomen and of feeling very bad. These symptoms continuing, she was sent to the hospital. Upon admission to the hospital the pulse was 106, temperature 97°, respiration 22. The patient looked very ill. The expression was anxious, marked pallor with a bluish tinge to the lips, cold, clammy perspiration—in a word the typical picture of serious shock and hæmorrhage. There was fairly free bleeding from the vagina. The abdomen was very tender, the uterus was of a ligneous consistency and did not relax. Palpation of the fœtus was almost impossible, but the head was made out at the pelvic brim. The fœtal heart could not be heard. Vaginal examination disclosed the cervix dilated to admit one finger and not taken up. No placental tissue could be felt.

Diagnosis: Premature separation of a normally situated placenta with combined external and concealed bleeding. Fœtus dead.

In view of the fact that the patient was an elderly primipara, with an undilated cervix and losing blood rather freely, it was thought that immediate delivery was imperative and that cæsarean section was the most conservative method of accomplishing it. Five hundred cubic centimeters of salt solution were given by rectum and retained. Operation under ether anæsthesia. Iodine preparation. Ergotole and pituitrin were given hypodermically at the beginning of the operation. The abdomen was opened by an incision in the median line above and below the umbilicus. There was a considerable quantity of blood-stained serum in the peritoneal cavity. The uterus presented such a peculiar appearance that it was delivered from the abdomen to permit of closer inspection. The whole organ had a mottled, ecchymotic look, the colors ranging from that of the normal organ through blue to almost black. The discoloration was greater in the region of the left cornua. Both the anterior and posterior walls were involved. In addition to the discoloration a peculiar fissured appearance was noted. The fissures seemed to run, in the main, parallel with the long axis of the organ. The peritoneum did not seem to be torn through; the effect was more as though the superficial layers of muscle had been torn subperitoneally. The tubes and ovaries were apparently normal. Upon incision of the uterus the placenta was found attached to the left side of the anterior uterine wall and separated for about one-third of its surface. The uterus con-

tained over a quart of fluid and clotted blood. The female fœtus was dead and was removed in the intact membranes. The cord was wrapped twice around the neck and the amniotic fluid was stained with meconium but not with blood. There was some question as to the proper course to pursue in regard to leaving or removing the uterus; its appearance was most abnormal and at first it failed to contract well. After massage and the application of hot towels the contraction was more satisfactory and it was finally closed by interrupted sutures, a gauze pack having been first introduced with one end carried down into the vagina. One thousand cubic centimeters of salt solution were given by hypodermoclysis during the operation.

The patient returned to the ward with a pulse of 136 and reacted quickly. Her condition remained thoroughly unsatisfactory, however, and despite all the usual treatment she died about 3 hours after the operation.

Autopsy by Dr. Lester Neuman. Section made 12 hours postmortem. Body of a female over 30 years of age. Rigor mortis fairly well marked in all extremities. Inspection shows enlarged breasts, with pigmented areolæ, a recent median abdominal incision and the two points of entry for hypodermoclysis. The heart, lungs, and thoracic aorta are apparently normal. The abdominal cavity contains about 500 cubic centimeters of bloody fluid. The liver is pale and reduced in consistency. The gallbladder is apparently normal. The spleen is reduced in consistency. The stomach and intestines, aside from being pale, are apparently normal. The kidneys are pale and reduced in consistency. The urinary bladder is distended with urine.

The fallopian tubes and ovaries are apparently normal. The uterus is very much enlarged and shows a recent median incision on the anterior surface. There are present subperitoneal hæmorrhages over the entire uterus and the broad ligament of the left side. The uterine wall is very soft and the bundles of muscular fibers appear to be separated by considerable spaces. The cavity of the uterus is packed with gauze and shows no sign of hæmorrhage.

Anatomical diagnosis. While no exact anatomical diagnosis can be made, the pale and soft condition of the various organs and the presence of a considerable quantity of bloody fluid in the abdominal cavity, plainly indicate a marked anæmia, which undoubtedly was an important contributory factor in the clinical diagnosis of shock.

Microscopical examination. There is a central necrosis of the lobules of the liver, showing especially a slight biliary pigmentation and slight fatty degeneration. The kidneys show acute parenchymatous degeneration of a marked degree, involving especially the convoluted tubules. The uterine musculature appears normal with the exception of marked hæmorrhagic extravasations between the bundles of muscle fibers. The placenta is apparently normal with the exception of a slightly hyaline appearance of the stroma of the villi.

SUMMARY OF THE CLINICAL DATA IN TABLE I

Age. This was mentioned in 59 cases. The youngest patient was 17, the oldest 42, and the average age was 32.2 years.

Parity. This was given in 67 cases. Of these 18 were I-paræ; 1, II-para; 6, III-paræ; 5, IV-paræ; 5, V-paræ; 5, VI-paræ; 4, VII-paræ; 5, VIII-paræ; 5, IX-paræ; 2, X-paræ; 1, XI-para; 5, XIII-paræ; 1, XIV-para; and 4 were stated to be multiparæ. Of the 67 cases, therefore, 26.8 per cent were primiparæ, 73.1 per cent multiparæ, and the average parity was 5.3.

Period of gestation. This was mentioned, more or less definitely, in 58 cases. Some authors refer to calendar and some to lunar months. As near as could be determined, however, the condition developed at the following periods, in the number of cases indicated: In the seventh month, 5 cases; in the eighth month, 10 cases; in the ninth month, 21 cases, and in the tenth month and at term, 22 cases.

Symptoms of toxæmia. The condition of the urine was mentioned in 51 cases. It was stated to have been normal in 7 cases. Albumin was present in quantities varying from a trace to an amount sufficient to justify the terms "loaded" and "solid" in 44 cases. It was therefore present in 86.2 per cent of the cases. Casts were noted in 12 cases, always in association with albumin. Blood was mentioned in several cases but it was not always possible to determine whether catheterized specimens were referred to.

It is surprising to note that, although the majority of the cases are only recently reported, the blood pressure was mentioned in only 9 cases. The maximum systolic pressure readings in these cases were 100, 120, 160, 170, 174, 180, 200, 260, and 280, the average being 182.

Various other clinical manifestations of toxæmia were noted. Jaundice was noted in 1 case; œdema in 12 cases; headache in 7 cases; vomiting throughout pregnancy in 1 case; and visual disturbances in 6 cases, 1 case having albuminuric retinitis, and 2 patients being blind. Eclampsia was present in 6 cases.

In 55 cases in which something definite is said regarding the presence or absence of clinical evidence of toxæmia, the condition of the patient indicates its absence in 7 cases and its presence in 48 cases; in other words, toxæmia is indicated clinically in 87.2 per cent of the cases. If here are added 2 cases in which distinct hepatic or renal lesions of a toxic nature were noted at autopsy although clinical evidence of toxæmia is not mentioned, the figures become 7 cases without evidence of toxæmia, and 50 with such evidence, or 87.7 per cent of 57 cases showing clinical or pathological evidence of toxæmia.

Character of bleeding. It is difficult to draw a sharp line of distinction between the cases of frank and concealed hæmorrhage because in the majority of instances there is at least an escape of blood-stained serum from the vagina. However, in 67 cases in which this point could be more or less

TABLE I.—CLINICAL DATA OF SIXTY-NINE CASES

Case Number	Reporter	Patient			Symptoms of Toxæmia			Result		Character of Bleeding	Degree of Separation	Method of Delivery	Remarks
		Parity	Age	Month of Pregnancy	Urine	Blood Pressure	Miscellaneous	Mother	Fœtus				
1	Desmond	XIV.	42	8				Died	Died	Concealed	Complete	None	Died undelivered
2	v. Weiss	III.	27	9	No albumin			Died	Died	Combined	Complete	Version and extraction	Death due to postpartum hæmorrhage
3	Knauer	VII.	35	7				Died	Died	Combined	Complete	Version and extraction	Ecchymoses on legs
4	Seitz	I.	17	9			Eclampsia	Died	Died	Combined	Partial	None	Died undelivered
5	Targett	VIII.	34	6	Albumin present		Œdema of legs	Recovered	Died	Combined	Complete	Porro	
6	LeLorier	III.	26	9	No albumin		General health good	Recovered	Died	Concealed	Complete	Cæsarean section	Uterus made to contract with difficulty
7	Bar and Kervily	VI.		7			Previous good health	Died	Died	Combined		Cæsarean section	
8	Pulvirenti	I.	38	7	Much albumin and hyaline and granular casts		Chronic nephritis	Died	Died	Concealed	Complete	Hysterectomy without opening the uterus	
9	Keyworth	VIII.	34	9				Died	Died	Combined	Partial	Spontaneous	Persistent oozing from lacerations of the vulva
10	Kerr	IV.						Died	Died	Combined		Porro	
11	Couvelaire	I.	26	9	Considerable albumin	200	Œdema of legs, headache, visual symptoms and albuminuric retinitis	Recovered	Died	Concealed	Complete	Porro	
12	Couvelaire	V.	35	9	Operative specimen contained albumin		Vomiting throughout pregnancy, headache, œdema, and visual disturbances	Died	Died	Combined	Complete	Porro	
13	Couvelaire	I.	23	8	Albumin present	280	Eclampsia	Died	Died	Concealed		Spontaneous delivery	Renal decapsulation. Eye grounds and lumbar fluid negative
14	Zweifel	III.	26	9	Considerable albumin			Recovered	Died	Combined	Complete	Hysterectomy without opening the uterus	
15	Berggren	IV.	37	9	Much albumin, hyaline and granular casts, and renal epithelium			Recovered	Recovered	Combined	Complete	Cæsarean section	
16	Kynoch	IX.		9				Died	Died	Concealed	Partial	None	Died undelivered
17	Fieux	Multipara			Albumin present			Died	Died			Version and extraction	Death due to postpartum hæmorrhage

18	Labre and Bourret	VI		0			Pregnancy had been normal	Died	Died	Combined		Manual dilatation of cervix and craniotomy	Syphilis
19	Bar							Died				Extraction of foetus	
20	Spaeth	I	8					Recovered	Recovered	Combined	Partial	Cæsarean section	
21	Jentter	Multipara	32				General œdema	Died	Died	Combined		Porro	Uterus failed to contract
22	Essen-Moeller	V	31	9	Albumin and casts			Died	Died	Combined	Partial	Version and extraction	Death from tear of cervix and hæmorrhage
23	Essen-Moeller	IV	37	9	Albumin and casts			Recovered	Recovered	Combined	Partial	Cæsarean section	Baby died in a few days from a cardiac deformity
24	Essen-Moeller	V	31	7	A little albumin			Recovered	Died	Combined		Cæsarean section	Grönc's case
25	Essen-Moeller	I	21	9	Much albumin			Recovered	Died	Concealed	Partial	Cæsarean section	
26	Essen-Moeller	I	17	7	Albumin			Recovered	Died	Combined		Cæsarean section	Grönc's case
27	King	V	36	8	Trace of albumin			Recovered	Died	Combined	Complete	Porro	Wassermann negative
28	Shaw	XIII	12	9	Loaded with albumin			Died	Died	Combined		Spontaneous delivery	Hysterectomy for post-partum hæmorrhage. Right ureter ligated at operation
29	Clifford	II	8	9	Solid with albumin			Died	Died	Combined	Complete	Porro	
30	Zarate	Multipara		8			Eclampsia	Died	Died	Concealed	Complete	Manual dilatation and craniotomy	
31	Zarate	Multipara	36		Thickening of albumin		Eclampsia. Œdema of legs	Died	Died	Concealed	Complete	Spontaneous delivery	Hysterectomy for post-partum hæmorrhage. Death on table
32	Traipont	VIII	37	9	No albumin		No œdema	Died	Died	Combined	Complete	Version and extraction	Postpartum hæmorrhage contributed to death
33	Brandt	I	30		Albumin present			Recovered	Recovered	Combined		Cæsarean section	
34	Williams	I	24	8	Normal			Recovered	Died	Concealed	Complete	Porro	
35	Williams	I	18	9	Albumin and granular casts	100		Recovered	Died	Combined	Complete	Porro	
36	Brandt	XIII.	42	9	Albumin present			Died	Died	Combined		Vaginal hysterotomy	Hysterectomy for post-partum hæmorrhage

TABLE I. —CLINICAL DATA OF SIXTY-NINE CASES—*Continued*

Case Number	Reporter	Patient			Symptoms of Toxæmia			Result		Character of Bleeding	Degree of Separation	Method of Delivery	Remarks
		Parity	Age	Month of Pregnancy	Urine	Blood Pressure	Miscellaneous	Mother	Fœtus				
37	v. Franque	IV.	29					Recovered	Died	Combined	Complete	Hysterectomy without opening the uterus	
38	Oldfield and Hann	I.	38	8	Loaded with albumin. Blood in catheterized specimen		Œdema of feet and face, headache and almost complete blindness	Recovered	Died	Combined	Complete	Porro	Toxic state lasted about 2 weeks after delivery
39	Shaw	VII.	41	7	Considerable albumin			Recovered	Died	Combined	Complete	Porro	
40	Shaw	XI.	38	8	Considerable albumin			Died	Died	Concealed	Complete	Porro	
41	Shaw	IX.	32	8	Large amount of albumin			Recovered	Died	Combined	Complete	Porro	
42	Shaw	IX.	41	7	Large amount of albumin			Recovered	Died	Combined	Complete	Porro	
43	Shaw	XIII.	39	8	Large amount of albumin			Died	Died	Combined	Complete	Porro	Death due to slipping of ligature on uterine artery
44	Spencer							Recovered		Concealed		Cæsarean section	
45	Smith	X.		9				Died	Died	Combined		Hysterectomy without opening the uterus	
46	McNair	VI.	34	8	Trace of albumin			Died	Died	Concealed	Complete	Manual dilatation, craniotomy	
47	Huntington	I.	25	6	Solid with albumin	170	Jaundice	Died	Died	Combined		Cæsarean section	Death due to peritonitis
48	Mazzini	I.	22	6	No albumin		No œdema	Recovered	Died	Concealed	Partial	Excision of uterine horn	Uterus didelphys. Pregnant horn rotated 180 degrees
49	Hillis	I.	35	9	Slight amount of albumin, no casts	120		Recovered	Recovered	Combined		Cæsarean section	Uterus made to contract with difficulty. Blow on abdomen 4 days before attack
50	Wing	I.	22	8				Recovered	Died	Combined	Partial	Cæsarean section	Fell, striking abdomen, about 3 hours before pains began
51	Morse	VIII.	39	8	Trace of albumin, no casts		Pregnancy normal except for nausea and constipation	Recovered	Died	Concealed	Complete	Porro	

52	Morse	XIII.	40	8	Heavy trace of albumin and casts	160		Died	Died	Combined	Partial	Porro	Nephritic toxæmia in preceding pregnancy. Death due to pneumonia
53	Grow	X.	33	7	Albumin present		None	Recovered	Died	Combined		Porro	Accidental hæmorrhage in ninth pregnancy
54	Smyly	III.	30		Loaded with albumin and hyaline and granular casts			Recovered	Died	Concealed	Complete	Cæsarean section	
55	Smyly	IX.	39	9	Albumin, blood and casts	200	Headache and impaired vision	Recovered	Died	Concealed	Complete	Cæsarean section	Patient took fits, weeks before attack. Ecchymoses on left buttock
56	Ahlström	V.	29	6	Albumin present		Œdema of face and legs for 3 months	Died	Died	Combined		Vaginal hysterotomy	Postpartum hæmorrhage caused death
57	Ahlstrom	VIII.	39	9				Died	Died	Combined		Version and extraction	Postpartum hæmorrhage caused death
58	Ahlström	III.	33	9	Normal			Died	Died	Combined	Complete	Bossi dilator and craniotomy	Postpartum hæmorrhage caused death
59	Vogt	IV.	34	7			Eclampsia	Died	Died	Concealed	Partial	Cæsarean section	
60	Quigley	VI.	33		Albumin present	174	Headache, œdema and visual disturbance	Recovered	Died	Combined		Cæsarean section	Toxæmia, short cord, and fall
61	Lieven	VII.	33	9	No albumin			Died	Died	Combined	Complete	Version and extraction	Death due to postpartum hæmorrhage
62	Harrison	I.	26	8	Distinct trace of albumin		Œdema of leg	Recovered	Died	Combined	Complete	Cæsarean section	
63	Lee	IX.	41	9	Thick cloud of albumin and granular casts		None. Well until day of attack	Died	Died	Combined	Complete	Manual dilatation of cervix, rupture of membranes, vaginal plug, 1 ampoule of pituitrin, finally delivered with forceps	Hysterectomy for rupture of the uterus
64	Lee	XIII	42	8	Albumin, hyaline and granular casts		None. Well until day of attack	Died	Died	Combined	Complete	Porro	
65	Lee	VII.	37	9	Much albumin, hyaline and granular casts		Frontal headache preceded attack for 24 hours	Died	Died	Concealed	Complete	Porro	
66	Lee	VI.	37	9	Albumin present		Œdema of legs and fainting attacks for 2 days	Recovered	Died	Concealed	Complete	Cæsarean section	Uterus relaxed at first but finally contracted well. Wassermann negative
67	Lordyce and Johnstone	I		9	Large amount of albumin. Suppression		Eclampsia. Œdema of trunk and limbs	Died	Died	Combined	Partial	Porro	
68	Snowden	III	37	7	Albumin and hyaline and granular casts	180	Œdema of face and feet, headache, amaurosis	Recovered	Died	Concealed	Complete	Cæsarean section	Bleeding for several days from the abdominal incision
69	Willson	I.	37	9	Albumin had been present previously but not at time of attack			Died	Died	Combined	Partial	Cæsarean section	

accurately determined. I have classified 46 cases in the frank or combined type, 68.6 per cent of the cases, therefore, having frank bleeding.

Degree of placental separation. In 48 cases in which this point could be determined, the separation was complete in 36 cases, and partial in 12 cases.

Method of delivery. The Porro operation was performed 21 times; conservative cæsarean section 21 times; abdominal hysterectomy without opening the uterus 4 times; vaginal hysterotomy 2 times; abdominal hysterectomy for rupture of the uterus once; excision of the pregnant horn of a uterus didelphys once; extraction of the fœtus 12 times (forceps, craniotomy, version and extraction); spontaneous delivery occurred in 4 cases; abdominal hysterectomy to control postpartum hæmorrhage was done 3 times; 3 patients died undelivered.

Mortality. There were 38 maternal deaths in 69 cases, a mortality rate for the whole series of 55 per cent. There were 62 fœtal deaths in 67 cases, a mortality rate of 92.5 per cent. This series of cases, however, includes only cases of accidental hæmorrhage associated with hæmorrhagic infarction of the uterus. The diagnosis, therefore, was only possible either at autopsy or laparotomy, and hence it becomes necessary in figuring the mortality rate to eliminate all cases in which the diagnosis was established postmortem. Doing this we find 19 maternal deaths in 50 cases in which the diagnosis was established during life by means of a laparotomy, a mortality of 38 per cent. The five children which survived were all delivered by cæsarean section, there being no case in which the fœtus survived delivery through the vagina.

The maternal mortality rates for the various methods of delivery were as follows: For the Porro operation, 10 deaths in 21 cases, a rate of 47.6 per cent; for conservative cæsarean section, 4 deaths in 21 cases, a rate of 19 per cent; for hysterectomy without opening the uterus, 2 deaths in 4 cases, a rate of 50 per cent; the case of hysterectomy for uterine rupture resulted fatally, as did the 3 cases of hysterectomy for postpartum hæmorrhage.

Miscellaneous observations. The Wassermann reaction in 2 cases in which it was mentioned was negative. One patient was syphilitic. Ecchymoses in the skin were present in 2 cases, a large ecchymosis on the left buttock in 1 case, and an ecchymotic mottling of the legs in another. Peritonitis is stated to have caused death in 1 case, following cæsarean section. Slipping of a ligature on the uterine artery following a Porro operation caused another. The right ureter was ligated in 1 case in which hysterectomy was necessary to control postpartum hæmorrhage. Death was attributed to an acute exacerbation of a chronic colitis, however. Postpartum hæmorrhage caused death in 11 cases, all delivered through the vagina, but does not seem to have contributed to the death of any patient on whom conservative cæsarean section had been performed.

SUMMARY OF PATHOLOGICAL DATA IN TABLE II

Macroscopical appearance of the uterus. At autopsy or laparotomy the uterus presents a very striking picture, its appearance being compared by many to that of an ovarian cyst with a twisted pedicle. The whole organ may be almost black or mottled throughout from the presence of the effused blood in its walls or under the peritoneum, or one lateral half or the anterior or posterior surface may appear normal and the opposite portion show the characteristic discoloration.

The myometrium. As might be expected, the extent of the hæmorrhagic infiltration of the uterine musculature varies greatly. Subperitoneal ecchymosis due to extravasation of blood under the peritoneum seems to be present in all cases, and in a few is the only lesion noted. Between such cases as these and those in which the whole uterine wall is literally inundated with blood, all stages in the process are encountered. The hæmorrhage constantly tends toward separating and tearing apart the muscle bundles, but it is only in the areas where it is most intense that the individual fibers are separated from each other. This rarely occurs. In such localities the muscle bundles may be seen occasionally as strands of tissue traversing great lakes of effused blood. Œdema is very frequently noted, and areas free from hæmorrhage often show much œdematous infiltration. Increase in the amount of connective tissue is noted occasionally. Round-celled infiltration around some of the hæmorrhagic foci has been noted, and also the presence of leucocytes containing blood pigment. Such areas probably indicate that successive effusions of blood occur, some older and some more recent.

The distribution of the hæmorrhage in the uterine wall is interesting and, from an etiological point of view, most suggestive. The process is always worse in the region of the fundus and upper part of the body, and the lower uterine segment seems to be frequently entirely spared. In the great majority of the cases the area of the uterine wall over the site of the placenta is the most involved and the extravasation is usually worse on the anterior, posterior, or lateral aspect of the uterus, depending upon the location of the placenta. Another striking finding is the tendency of the hæmorrhagic process to reach its acme under the peritoneum. There are a few exceptions to this, but the great majority of the observers note particularly and specifically that it is the outermost layers of the myometrium which show the densest and deepest discoloration from the bloody effusion. In this connection it should also be remembered that in the milder cases the lesion may be limited to subserous ecchymoses. Even over the area of placental attachment the layers of musculature adjacent to the decidua may show only punctiform bleedings, which increase as the peritoneum is approached until the outermost third of the thickness of the uterine wall is literally torn asunder by a massive and brutal hæmorrhage.

This is illustrated most strikingly in the colored plate of Fordyce and Johnstone, showing a cross section of the uterus through the placental site at a level just below the tubal insertions.

The observations regarding the condition of the muscle fibers themselves are rather contradictory. In 14 cases in which this point is mentioned they are stated to have been normal or healthy in 7 cases and abnormal in 7 cases. The most detailed study of the muscle fibers was made by Ley. He found marked degeneration present in 3 uteri studied. This seemed to be more marked in regions where the hæmorrhage was greatest, but was not limited to such areas, and, in his opinion, was not secondary to the hæmorrhage but was due to the same cause, namely the action of a toxin. The process was severe enough in some areas to reduce the muscle bundles to a "vacuolated matrix in which lie a very few tortuous, narrow, hyper- and hypo-chromatic nuclei." The individual fibers is such areas could not be recognized.

The decidua. The changes in the decidua are always worse in the decidua basalis than in the parietal decidua. Hæmorrhage is the most marked lesion and is extensive enough in a few cases to cause complete disorganization. Degeneration and necrosis of the decidual cells has been noted. The decidual vessels show congestion. In the case of Young (the specimen of the case reported clinically by Kynoch) it is stated that the decidual vessels were dilated into enormous thin-walled sinuses. Ley mentions a partial closing of the decidual vessels by proliferation of the intima in one case, and some perivascular infiltration in another. Inflammatory lesions were not noted in any case and their absence was noted specifically in a few cases.

The blood vessels. Congestion, particularly of the veins, is quite uniformly present. Thrombosis of the veins in the uterine wall, particularly in the neighborhood of the placental site, is noted in several cases. Couvelaire and Williams noted solutions in the continuity of the walls of some veins communicating with the areas of effusion. Williams and Morse noted changes of an endarteritic nature in the walls of the smaller arteries, but the latter states that these did not differ from those usually encountered in the uteri of multiparous patients. Mazzini noted thrombosis in some vessels and a homogeneous appearance in the walls of others. Young states that: " . . . a massive, extensive, and fairly old standing thrombosis was found in the ovarian vessels on each side, especially the left. The uterine vessels seem to be healthy." Perivascular infiltration was noted by Ley, who also states that the changes in the vessel walls did not seem to differ from those noted in the surrounding tissues. Berggren, v. Weiss, Fraipont, Couvelaire, Essen-Moeller and Ahlström, all note the vessel walls as being normal.

The peritoneum. The presence of subperitoneal hæmorrhagic effusion in all cases has already been noted. The most striking lesion in the peritoneum, however, and one of great importance from both a clinical and pathological point of view, is the presence in many cases of fissures or ruptures in the peritoneum, extending occasionally to the depth of a few millimeters into the subjacent muscularis. These are noted in 11 cases. (Essen-Moeller, Fraipont, King, Knauer, LeLorier, Ley, McNair, Shaw, Smith, Smyly, and Zweifel.) This represents an incidence of approximately 15 per cent. They may be single or multiple. Their direction is usually transverse, but they may also be directed in the long axis of the uterus, or have an irregular arrangement. Their position is usually on the anterior or posterior wall in the region of the fundus. It is very probable that they occur, in most instances, directly over the placental site, and such a location is definitely shown in 3 cases. I have not included in this series several cases in the literature in which these peritoneal fissures have been noted in association with accidental hæmorrhage but in which nothing is said regarding hæmorrhage into the uterine wall. There would seem to be little doubt, however, that these belong to the type of condition under discussion. Such cases are reported by White, Shannon, Macirone, and Werner. The case of White is particularly interesting because it is, in all probability, the first case of uteroplacental apoplexy in the literature. The patient, a 32-year-old IX-para, died about an hour after the delivery of a stillborn fœtus. Nothing is said about external or concealed hæmorrhage but autopsy showed the characteristic peritoneal lacerations, hæmorrhagic extravasations into the broad ligaments, and intra-abdominal bleeding. This case was reported in 1834.

Intraperitoneal effusion. In 31 cases in which this point is mentioned the presence of an intraperitoneal effusion is noted in 22 cases, an incidence of 71 per cent. The character of the effusion varied from a clear serum to pure blood. The amount varied from a slightly increased quantity of peritoneal fluid to an intra-abdominal hæmorrhage quite comparable to that caused by a ruptured ectopic pregnancy. In the majority of the cases the source of the bleeding is evidently the superficial lacerations described above. In one case it came from ruptured vessels in the broad ligament, in another is believed to have come from the wall of the tubes, and in still another was at least contributed to by complete rupture of the uterus. The cases with bloody serum frequently showed no peritoneal tears, the opposite being true when free blood was present.

The adnexa. Not the least interesting feature of the pathology is the participation of the tubes, ovaries, and uterine ligaments in the hæmorrhagic process. The broad ligaments were involved in 26 cases, the tubes in 11 cases, the ovaries in 4 cases, and the round ligaments, once. These were, of course, associated in various combinations. The lesion in the ovary was usually simply the presence of punctiform hæmorrhage. In one of Williams' cases this was extensive enough, however, entirely to isolate some graafian follicles in a bloody effusion. Punctiform hæmorrhage in the tubal wall was the

TABLE II.—PATHOLOGICAL DATA IN FORTY-SIX CASES

(Case numbers in this table correspond with those in Table I.)

Case No.	Infiltration of the Uterine Wall	Muscle Fibers	Decidua	Blood Vessels	Peritoneal Lacerations	Adnexa	Intraperitoneal Effusion	Other Organs
2	Marked ecchymosis at the fundus. Round-celled infiltration around some of the hæmorrhagic areas			Walls normal in appearance		Broad ligaments infiltrated. Right tube filled with blood	Blood and serous fluid	
3	Bloody effusions under the serosa				On posterior surface in long axis of uterus	Effusions in broad ligaments	Free blood	Chronic nephritis. Hæmorrhagic hepatitis
4	Small hæmorrhages between the muscle bundles toward the decidua		Cellular degeneration and hæmorrhage	Normal				Kidneys: parenchymatous nephritis and œdema. Liver: necrosis and hæmorrhage. Pulmonary tuberculosis. Hæmorrhage in membranes of brain
6	Worse under the peritoneum	Healthy			One tear about 2 cm. long over placental site			
7	Uterine wall appeared ecchymotic						No blood or bloody serum	Kidneys: chronic parenchymatous nephritis. Liver: central necrosis, advanced grade
8	Numerous punctiform hæmorrhages and subserous effusions							Hepatic cirrhosis and chronic nephritis
9	Irregular subperitoneal "bruising," chiefly around the cornua					Large extravasation in left broad ligament. Both tubes contained blood	15 ounces of free and clotted blood	One small hæmorrhage on the convexity of diaphragm, another on the visceral pericardium
11	Marked throughout. Much worse in area of placental attachment, where all layers are involved. Elsewhere worse in middle and superficial layers. The muscle bundles are separated and even individual fibers disassociated		Parietal, normal; basalis, unrecognizable because of hæmorrhagic infiltration	Large and congested but intact, with their walls and endothelium normal		Punctiform hæmorrhages in walls both tubes and in both ovaries. Both broad ligaments infiltrated		Fœtus: Macroscopical examination showed hæmorrhagic effusions into the liver, kidneys, adrenals, and cerebral meninges
12	Limited to the placental site. Œdema	Appear normal		Walls of some veins have given way. Those of the arteries intact and normal. Some perivascular infiltration		Discrete ecchymoses in both broad ligaments		
13	Worse at the placental site. Wall involved to a depth of 1 cm. below the peritoneum. Lower uterine segment not involved. No œdema			No changes in the vessel walls		Ovaries and left tube normal. Right tube and broad ligament infiltrated	Slight bloody effusion in the cul-de-sac	Parenchymatous degenerative lesions in kidneys. Liver normal on gross and microscopical examination
14	Ecchymosis				On posterior surface of fundus		Blood and bloody serum	

15	Muscle bundles disorganized by œdema and hæmorrhage			Polymorphonuclear leucocytosis present in abundance in some vessels, but the structure of the walls is normal. No inflammatory reaction			Free blood	
16	Œdema. Hæmorrhagic leakage through vessel walls. Infiltration worse at placental site	No evidence of degeneration anywhere	Expansion of the vessels into enormous thin walled sinuses. Here and there areas show hæmorrhage. Changes most marked in the basalis	Congestion of those in the uterine wall, otherwise healthy. Massive, extensive and fairly old standing thrombosis of the ovarian veins, especially the left				
22	Present				Present			
27	Marked throughout, from decidua to the peritoneum. Œdema. Occasional collections of leucocytes in greater numbers than can be accounted for by the effused blood	Appear degenerated; nuclei stain poorly			Slight abrasion on posterior surface involving peritoneum only	Large hæmatoma in left broad ligament, extending up behind the sigmoid	No free blood present	
28	Free blood among the muscle bundles. Large amount of fibrous tissue but no increase in amount of elastic tissue				Present, on posterior surface	Both broad ligaments swollen and infiltrated, large hæmatoma in the right. Infiltration extends up behind the cæcum	½ pint of free unclotted blood	Kidneys normal on gross and microscopical examination
29	Present					Ruptured veins in right broad ligament source of free blood	Large amount of free blood	
31	Both recent and old hæmorrhagic extravasations; some proliferation of connective tissue; some round celled infiltration	Many fibers show degeneration	Areas of hæmorrhage				100 grams of extravasated blood in cul-de sac	
32	Marked throughout all layers, especially at the placental site	No degeneration		No visible alterations of the walls	2 transverse fissures on posterior surface of fundus, directly over placental site, extending a few millimeters into the muscularis		1 litre of blood	No lesions in lungs, liver, spleen, kidneys, or intestines on gross examination
33	Present					Broad ligaments infiltrated		
34	Worse on posterior wall and right side; placenta on posterior wall		Normal; no trace of inflammation	Free hæmorrhages in the walls of many veins communicating with the effusions. Thrombosis of the smaller veins. Degenerative changes in the walls of smaller arterioles. Main trunks of the vessels normal	None	Right broad ligament and lateral two-thirds of tube infiltrated	No free blood	Placenta normal

TABLE II. PATHOLOGICAL DATA IN FORTY-SIX CASES—*Continued.*

Case No.	Infiltration of the Uterine Wall	Muscle Fibers	Decidua	Blood Vessels	Peritoneal Lacerations	Adnexa	Intraperitoneal Effusion	Other Organs
35	Œdema. Hæmorrhage not apparently connected with larger vessels. None in outer half		No inflammatory changes; some small hæmorrhagic areas	Superficial veins distended. Veins near the placental site filled with thrombi Degenerative changes in the walls of smaller arterioles. Main uterine and ovarian vessels normal	None	Right broad ligament, tube and ovary infiltrated	Quantity of clear serous fluid	Placenta normal
38	Patchy effusions under peritoneum. Cut surface black from effused blood	Disassociated				Tubes, ovaries, and broad ligaments all involved. Ecchymoses extend onto bladder in front and up behind cæcum on right and sigmoid on left		Placenta normal. Fœtus: chocolate colored intestines, bloody effusions under peritoneum and bloody serum in the peritoneal cavity
39	Hæmorrhage under peritoneum and in superficial layers of the myometrium					Large hæmatoma in left broad ligament; none in right	1½ pint of free blood	
40	Hæmorrhage under peritoneum and in superficial layers of the myometrium					Both broad ligaments enormously distended with large hæmatoma	No free blood	
41	Hæmorrhage under peritoneum and in superficial layers of the myometrium					Very large hæmatoma in left broad ligament and smaller in right	No free blood	
42	Hæmorrhage under peritoneum and in superficial layers of the myometrium					Large hæmatoma in right broad ligament, none in left		
45	Ecchymosis				2 fissures, vertical, on posterior surface of fundus		8 ounces free blood	
46	Numerous subserous hæmorrhages. Patchy distribution of infiltration. Placenta on the anterior wall	Apparently healthy			Numerous on anterior surface, directly over placental site. Some extend into muscularis		24 ounces of free blood	Anæmic but apparently free from disease
47	Ecchymosis							Acute toxic degeneration of the liver, no normal liver tissue left
48	Present	Uniform degeneration		Thrombosis of some vessels; walls of others present homogenous appearance; congestion of the subserous vessels		Punctiform hæmorrhages in left tube and ovary. Left broad ligament infiltrated		Torsion of left horn of a uterus didelphys 180° to right

51	Worse at attachment of broad ligaments to fundus. Infiltration extends to a depth of 0.5 to 1 cm. beneath the peritoneum. Worse on anterior wall while placenta was on posterior wall. Œdema. Hæmorrhage from capillaries. Inner layers of myometrium normal	Disassociated	Numerous hæmorrhages into basalis. No leucocytic infiltration	Uterine and ovarian vessels normal in appearance and not thrombosed. Thrombosis of several veins in uterine wall at placental site. Arterioles show degeneration and thickening of subendothelial tissues		Tubes and ovaries not involved. Upper and median portions of broad ligaments infiltrated	Small amount of serous fluid	
52	Most intense in outer half of wall. Œdema	Disassociated	No inflammatory changes	Veins engorged and diapedesis occurring. No thrombosis. Arterial changes similar to those in case 51		Tubes and ovaries not involved. Ecchymotic spots in upper portions of both broad ligaments		
54	Subperitoneal patches of effusion. Wall infiltrated throughout				Peritoneum raised in large blebs filled with blood; one had ruptured		Free blood	
56	Ecchymosis worse on right side and anterior wall; distinctly worse in superficial layers. Placenta on anterior wall. No œdema	No changes	Hæmorrhagic areas. Some areas show degeneration	Veins congested; vessel walls normal, no thrombosis of ovarian or uterine vessels	None	Ovaries normal. Both tubes, both broad ligaments, and 1 round ligament infiltrated	400 ccm. blood-stained fluid	Subcapsular hæmorrhages in liver; no necrosis. Degenerative lesions in kidneys. Numerous small subcapsular hæmorrhages in adrenals
57	Distinctly worse under peritoneum. No œdema			No changes				Subcapsular hæmorrhages in liver. Punctiform hæmorrhages in mucosa of stomach
58	Only at placental site and only to a depth of 2 to 5 mm under the peritoneum. No œdema			No changes in vessel walls or thrombosis		Not involved	No effusion	
60	Subperitoneal ecchymosis only						About 2 pints of serosanguineous fluid	
61	Subperitoneal ecchymosis				Present	Both broad ligaments infiltrated		Generally anæmic, otherwise normal. Kidneys normal on microscopic examination
63	Marked. Œdema	Marked degeneration and necrosis at placental site and throughout the uterine wall	Basalis infiltrated with blood	Slight perivascular infiltration. Musculo-elastic hypertrophy of the intima of the larger arteries. Decidual veins partly closed by proliferation of intima		Both broad ligaments infiltrated. Tubes and ovaries normal	Large amount of free blood and clots. (Rupture of uterus)	Œdema and degeneration of kidneys. Fatty granules in liver cells, most numerous in center of lobules
64	Infiltration marked, in places worse over decidua, in others under peritoneum. Œdema	Marked degeneration and necrosis		Perivascular infiltration slight. Intimal proliferation in a few large veins. Swelling and œdema of walls of veins and arteries. Changes in vessel walls resemble those in surrounding tissues	Not present	Upper portion of left broad ligament infiltrated	Some blood stained fluid	Degenerative lesions in kidneys
65	Infiltration marked, in places worse over decidua, in others under peritoneum. Œdema	Marked degeneration and necrosis		Perivascular infiltration with lymphocytes in uterine wall and decidua			No free blood present	Severe parenchymatous degeneration of liver and kidneys. Diaphragm shows extensive hæmorrhage into lipomatous tissue beneath the pleura

TABLE II. PATHOLOGICAL DATA IN FORTY-SIX CASES—*Continued.*

Case No.	Infiltration of the Uterine Wall	Muscle Fibers	Decidua	Blood Vessels	Peritoneal Lacerations	Adnexa	Intraperitoneal Effusion	Other Organs
66	Subperitoneal hæmorrhage in regions of cornua				2 transverse lacerations on posterior surface, one involving peritoneum only, other muscularis slightly		1½ pints free blood	
67	Most marked in region of right cornua. Placenta on posterior and right lateral wall. Hæmorrhage subperitoneal in this region	All stages of degeneration in hæmorrhagic areas	Normal	Thrombosis of veins in uterine wall	None	Right broad ligament and proximal half of right tube involved	No free blood	Placenta normal except for infarcts. Liver: multiple subcapsular hæmorrhages; microscopically, hæmorrhage, necrosis and fatty degeneration. Degeneration in kidneys
68	Present				None	Tubes and broad ligaments infiltrated	None	
69	Ecchymosis worse at left cornua. Placenta attached to left side of anterior uterine wall	Appeared normal			Peculiar fissured appearance as though superficial layers of muscle had separated subperitoneally	Tubes and ovaries normal. Left broad ligament infiltrated	Considerable blood stained serum	Liver: central lobular necrosis. Kidneys: acute parenchymatous degeneration. Other organs normal. Placenta normal

usual lesion, but was occasionally extensive enough to quite disorganize it. The process in the broad ligaments varies greatly in its extent from the presence of ecchymotic spots to collections of blood which justify the term hæmatoma. The hæmorrhagic effusion may even extend beyond the broad ligaments; in one case onto the bladder, and posteriorly retroperitoneally as far as the cæcum on the right and the mesosigmoid on the left; in another case up behind the cæcum; and in a third up behind the sigmoid. The lesions in the broad ligaments, tubes, and ovaries are frequently unilateral, one side being free and the other involved, or the process is much worse on one side than on the other. Where this obtains there is distinct evidence to show that the severity of the condition is governed mainly by the location of the placental site, being worse on the side toward which the placenta tends to have its greatest area of attachment.

The placenta. With the exception of infarcts and the compressed zone corresponding to the area of the retroplacental hæmatoma, the few recorded examinations of the placenta have shown an absence of pathology. Slight thickening of the stroma of the villi was noted in a few cases.

Lesions in other organs. There are more or less complete autopsy notes in 17 cases. The lesions in the liver are hæmorrhage, usually subcapsular, and acute parenchymatous degeneration. Hæmorrhage without necrosis was present in 2 cases. Degeneration was noted 7 times and was central in 2 cases and peripheral in 1. Hepatic cirrhosis was noted once. In 1 case it is stated that no normal liver tissue was left. The liver is stated to have been normal on macroscopical examination once, and normal on both macroscopical and microscopical examination once. The usual lesion in the kidney was acute parenchymatous degeneration; this is noted 7 times. Chronic nephritis is noted twice. The kidneys were reported as normal on gross examination once, and on microscopical examination once. Hæmorrhage in the diaphragm was present twice, in the pericardium once, in the meninges once, in the mucosa of the stomach twice, and in the adrenals once. One patient had apical tuberculosis.

The fœtus. There are 2 autopsies on the fœtus reported, one by Couvelaire, and one by Oldfield and Hann. In each instance extensive hæmorrhages into various viscera were noted. Are these lesions the result of the asphyxia caused by placental separation, or are they a manifestation of the activity of the same hæmorrhagic toxin probably responsible for the similar lesions in the mother? As yet this question can not be answered. It is interesting to speculate, however, in view of recent claims that cerebral hæmorrhage in the newborn is often not of traumatic origin, but due to dyscrasias of the fœtal blood, whether a possible antenatal poisoning of the fœtus may not exist in some cases, which will enable us to trace an etiological relationship between cerebral hæmorrhage in the newborn and maternal toxæmia.

PATHOGENESIS

Clinicopathological summary. For the purpose of considering its pathogenesis, the picture of uteroplacental apoplexy detailed above may be summed up as follows: The placenta, normally located in the upper part of the uterus, is either partially or totally separated from its attachment to the uterine wall. The resulting intra-uterine bleeding may remain entirely concealed, but more frequently is manifested by external hæmorrhage. The uterine wall is the site of a hæmorrhagic extravasation, of varying extent and severity, which, however, tends to be worse in the neighborhood of the placental site and in the superficial, subperitoneal, rather than in the deeper layers. Œdema is frequently present. The muscular fibers frequently show varying degrees of degeneration, which may be very marked and extensive. The most constantly present vascular lesion is thrombosis of the smaller veins, especially back of the placental site. The decidua, particularly the decidua basalis, is the site of a hæmorrhagic infiltration and frequently shows necrosis. In about 15 per cent of the cases tears of the peritoneal coat are present. These may involve the myometrium to a depth of a few millimeters and are usually located over the placental site. Intra-abdominal bleeding from them is usually present and may be severe, or the effusion may be only a bloody serum. The broad ligaments, tubes, and ovaries are also very frequently the site of a hæmorrhagic infiltration. In about 90 per cent of the cases there is either clinical or pathological evidence of a toxæmia.

Theories regarding the causation of the lesion. The following theories have been advanced in the attempt to explain the causation of these lesions:

1. That the distention of the uterus from the intra-uterine hæmorrhage results in stretching its wall sufficiently to produce tearing of the vessels.

2. That the blood in the uterine wall is forced into it through its contraction over the intra-uterine hæmorrhage.

3. That obstruction to the venous flow from the uterus through torsion or other misplacement, or through thrombosis of the large venous trunks, results in a back pressure causing the smaller veins and capillaries to give way.

4. That the condition is the result of a toxæmia.

The first three of these hypotheses may be grouped together for consideration, as they all look toward a mechanical production of the lesions.

The mechanical theories. Morse has shown that filling the uterus of a pregnant bitch with salt solution, almost to the bursting point, will produce separation of the placentæ and abortion, but that hæmorrhage into the wall of the organ does not occur. It has already been seen, also, that the majority of cases in this series was of the frank type, and in many of these the external bleeding was not merely symptomatic but sufficient in amount to constitute a real menace to the patient, and yet in such cases the hæmorrhagic infarction has frequently been of a very severe grade. In the case of acute distention of other hollow viscera, short of actual rupture, hæmorrhage into the wall rarely occurs, and there seems to be no particular anatomical reason why the uterus should be an exception to this rule. Furthermore, the distention of the uterus in accidental hæmorrhage is rarely of the degree seen in acute hydramnios, which, so far as is known, does not cause hæmorrhage into the uterine wall.

That the hæmorrhagic infarction is not the result of the forcing of blood into the myometrium from the intra-uterine hæmorrhage is evidenced at once by a glance at the pathological picture. If this were so the infiltration should certainly be worse in the layers immediately adjacent to the decidua, instead of under the peritoneum, as is true in the great majority of the cases. Moreover, it seems difficult to believe that the attachment of the membranes to the uterine wall would resist separation more than the wall itself would resist infiltration. Hæmorrhage among muscular tissues elsewhere in the body normally searches out the lines of least resistance along the fasciæ and intermuscular septa. It seems reasonable to suppose that this is what occurs in accidental hæmorrhage, and the occurrence of frank bleeding in the majority of cases

demonstrates that a force necessary to drive the effused blood into and throughout the uterine wall, would first, and before such a point was reached, determine separation of the membranes, and external hæmorrhage, thus relieving the intra-uterine tension.

Obstruction of the venous flow from the uterus is held to be the causative factor by Young, and also by Morse; the former believes the obstruction to be due to thrombosis of the large veins; the latter looks to various malpositions of the uterus, torsional or otherwise, to cause the obstruction, and thinks the failure of the relaxed abdominal wall of the multipara to provide proper support to the uterus may be an important factor. Young's case was the only one in the series in which extensive thrombosis of the large veins was noted, and even here it was limited to the ovarian system, the uterine veins being normal. On the contrary, careful examination of the large veins, in several cases, failed to show the presence of thrombi. The experimental work of Morse on the uteri of pregnant rabbits, in so far as it can be applied to conditions in the human uterus, to my mind only serves to negative the hypothesis it is supposed to prove. He notes the fact that each horn of the rabbit's uterus is drained by three sets of veins, ovarian, mesometric, and uterovaginal. Ligation of any one, or of any two, sets of these veins resulted only in temporary congestion of the horn and did not deleteriously affect the pregnancy. When all three sets were ligated a condition was produced which clinically and pathologically corresponded to uteroplacental apoplexy. This result might have been reasonably expected, it would seem, but the further conclusion would be justifiably deducible, that such a result could be produced by nothing short of complete obstruction of the circulation. That this is true is proved by other experiments of the same authority, who found that torsion of a pregnant uterine horn in the rabbit, on the axis of the vagina, through an arc of 180 degrees, would produce placental separation but no intramural hæmorrhage. Not until the torsion had reached two complete rotations, was such a lesion produced.

The cases of Glinski, and of Mazzini, cited by Morse as corroborative clinical proof of his contention, tend, it seems to me, to further indicate its fallacy. In Mazzini's case, which I have included in this series because there was an undoubted hæmorrhagic infarction of the uterus present, the pregnant horn of a uterus didelphys was found definitely rotated through an arc of 180 degrees. In Glinski's case which I have not included because, while the uterus was congested and bled freely and the placenta was partially separated, there was no definite evidence of hæmorrhagic infiltration, there was a torsion of the uterus through an arc of 270 degrees. No other observation of malposition of the uterus has been noted, and Couvelaire, in comparing the appearance of the uterus in one of his cases to that of an ovarian cyst with a twisted pedicle, expressly states that the uterus was only rotated to the degree usually found present in pregnancy. While it is true that the pathology observed in pedunculated myomata and in ovarian cysts which have undergone torsion is not dissimilar to that in the uterine wall in the cases under discussion, here again, definite torsion, frequently of an extreme degree, is always present. In veterinary practice a condition of torsion of the pregnant uterus with hæmorrhage and placental separation is observed, but the torsion in these cases is sufficient to obstruct entrance into the uterus through twisting of the vagina or cervix (Rey, Williams). It is interesting to note that this was true in the case of Mazzini. It will thus be seen that in every clinical and experimental case in which a condition analogous to uteroplacental apoplexy has been produced through obstruction to the uterine circulation from torsion, the latter has been definite, of a marked degree, and easily demonstrable. It should be further noted that none of the mechanical hypotheses, with the possible exception of circulatory occlusion, offers a satisfactory explanation of the occurrence of the punctiform hæmorrhages in the tubes, ovaries, and uterine ligaments.

The most important objection which can be urged against the adequacy of any of the mechanical hypotheses, however, is their failure to account for the occurrence of the associated toxæmia. It is true that Morse states he has some experimental evidence to

show that torsion of the pregnant uterus in rabbits produces a toxæmia associated with renal lesions and albuminuria. His experiments along this line are as yet unpublished but it would seem entirely possible that such a torsion, which would probably close the uterus and prevent its emptying itself and at the same time cause fœtal death from placental separation, would, if it did not cause maternal death, rapidly result in a toxæmic state. Young, also, claims that the toxæmia occurring in accidental hæmorrhage is secondary, and not primary, to the placental separation. Briefly stated, his theory is that the toxæmias of pregnancy, including particularly eclampsia, are the result of the absorption into the maternal circulation of toxins derived from autolysis of infarcted areas in the placenta. His views have not received general acceptance and it is difficult to see, if his theory is correct, why toxæmia should not be a constant finding in those cases of placenta prævia in which, instead of one sudden, copious hæmorrhage, smaller hæmorrhages at intervals, spread over a period of weeks or even months, pointing to frequent separations of small areas of placenta. In addition, the clinical evidence adduced in the series of cases under discussion shows very definitely that toxæmic symptoms may precede the actual occurrence of placental separation for a varying period. In one of Smyly's cases this was true for a period of one month.

The toxæmic theory. If, then, we are justified in concluding that uteroplacental apoplexy is not the result of the operation of mechanical causes, except is such exceptional circumstances as those noted in Mazzini's case, the negative evidence that it must be the result of a toxæmic process becomes quite convincing. But the positive evidence is even more so. It has been shown that clinical or pathological evidence of toxæmia is present in approximately 90 per cent of the cases. In 8.7 per cent there has been an associated eclampsia. The degenerative parenchymatous lesions in the liver and kidneys, the hæmorrhages elsewhere in the body, in a word the whole clinical and pathological picture, is definitely toxæmic in character. In accord with this view are found practically all who have studied the subject, among whom may be mentioned Bar, Couvelaire, Essen-Moeller, Williams, Smyly, and Ley.

The nature, method of action, and source of the toxin. If it be granted that the lesions with which we are dealing are the result of the action of a toxin, in the absence of definite knowledge of its toxicology we can draw conclusions as to its nature only from a study of the lesions which it produces. Of these the most striking is hæmorrhage. Williams has compared the pathological picture of uteroplacental apoplexy to that caused by the venom of certain snakes. The comparison is indeed striking. The venom of all the viperine snakes, especially that of the American Crotalinæ, possesses hæmorrhagic properties of a marked degree, as has been shown clinically by Willson and experimentally by Flexner and Noguchi. The elaborate studies of venom made by the latter have demonstrated that these poisons contain protein toxins capable of producing hæmorrhage by a variety of mechanisms, namely: by inhibiting coagulation, by producing thrombosis, and by endotheliolysis. These toxins they have termed hæmorrhagins. The hæmorrhages in the uterine wall and in the adnexa, as has been previously shown, are associated with thrombosis of the smaller veins. The source of the bleeding has not been shown to have been arterial in any case, but solutions in the continuity of the vein walls, communicating with the areas of effusion have been noted, although the capillaries are probably mainly at fault. Such findings point to a process of endotheliolysis. Nor are clinical observations lacking that an inhibition of coagulation may be present. In this series, Snowden's case had oozing from the abdominal incision for several days; Keyworth's case had persistent oozing from superficial abrasions of the vulva and subcutaneous ecchymoses were noted in the cases of Smyly and of Knauer. DeLee has also reported a fatal case of accidental hæmorrhage associated with a hæmorrhagic diathesis; and Harrar has observed subcutaneous ecchymosis in the same condition.

Uteroplacental apoplexy is believed to be, then, a manifestation of the action of a toxin

which possesses properties justifying its being termed a hæmorrhagin. Acting on the tissues of the decidua basalis it produces small areas of hæmorrhage, which, coalescing, determine retroplacental bleeding and consequent placental separation. Acting in the uterine wall it produces lesions of continuity in the veins and capillaries, and also, probably, hæmorrhage by diapedesis. It causes thrombosis of the veins, and a resulting local passive congestion may contribute to the giving way of the vessels. In the decidual, muscular, and peritoneal tissues its toxic action tends to produce necrosis. The explanations of the peritoneal lacerations, which have usually been attributed to the distention of the uterus, is, in all probability, along toxic lines. The weakened and devitalized tissue gives way to the pressure of subperitoneal collections of blood. One of Smyly's cases shows this most strikingly, for, at operation, it was found that the peritoneal covering of the uterus was "in places raised in large blebs filled with blood, one of which on the posterior surface had burst, the rent being about one inch long, and there was free blood in the peritoneal cavity."

It is next necessary to examine the evidence to see if it will justify drawing reliable conclusions as to the source of the toxin. It has usually been held that there was present a general maternal toxæmia, probably closely related to eclampsia. The latter point will be dealt with later. The question here is as to which is the primary lesion, the infarction in the uterus or the general toxæmia. If we accept the hypothesis that the general toxæmia is primary it becomes necessary to assume, it would seem, that we are dealing with a toxin of hæmorrhagic properties with a selective action on the tissues most involved, that is the decidua, myometrium, parametrium, perimetrium, and ovaries. A toxin with such a diversity of biochemical affinities seems unlikely. And yet, with a general toxæmia of the mother as the important etiological factor, how else can the pathological picture be explained? If there is a generally and equally distributed hæmorrhagic toxin present, bleeding should be much more frequently encountered throughout the body, instead of in the uterus and adnexa in such overwhelming degree. It might be suggested that the toxin has an affinity for the tissues of the decidua basalis, produces bleeding there, and that the conditions throughout the uterus are secondary to the placental separation. But such a mechanical explanation has been shown to be untenable.

On the other hand, if we accept the hypothesis, here advanced for the first time, that the source of the toxin is the placenta, the pathological data accurately support this contention. The sequence of events may be briefly sketched as follows: Through the operation of unknown factors, a dysfunction of the placenta becomes established, resulting in the formation and liberation into the blood stream of the mother of a toxin of the nature of a hæmorrhagin. Being absorbed from the placental site, the hæmorrhagic tendency of the toxin would be first and most strongly manifested here. Hence the lesions would be worse in the uterus and its adnexa, and along the path of their lymphatic and venous drainage, namely behind the posterior parietal peritoneum, as in the cases cited. The tendency of the hæmorrhagic extravasation, œdema, necrosis, and peritoneal laceration to be most intense at the placental area is explained. Recalling the rich network of blood and lymphatic vessels just below the peritoneum, the accumulation of the toxin in these accounts for the greater extravasation almost uniformly noted in the superficial layers of the myometrium and under the peritoneum. The general distribution of the toxin throughout the body results in producing renal and hepatic degenerative changes, and occasionally, but not universally, the hæmorrhagic nature of the poison is manifested elsewhere by the occurrence of hæmorrhages in various viscera, ecchymoses in the skin, etc. The hypothesis which I wish to advance may be briefly summed up as follows: There is a hæmorrhagic toxin liberated by the placenta which produces its maximum effect locally, at the site of its innoculation, so to speak, and secondarily produces manifestations of a general toxæmia.

Relation to the other toxæmias of pregnancy. This question, naturally of the greatest im-

portance and interest, is, unfortunately, in the present state of our knowledge, impossible of very definite discussion. The consensus of those who have most studied the subject seems to be to accept a close relationship between uteroplacental apoplexy and eclampsia, and in this series, eclampsia was a complication in 8.7 per cent of the cases. This view of the matter can not be better summed up than by quoting Essen-Moeller, who says, after mentioning the opinion noted above:

"Are there any facts supporting such an opinion? In the first place it must be remembered that the coincidence of eclampsia and accidental hæmorrhage is by no means rare. Many such cases have been published and among my cases I have had 2. Moreover, in cases of eclampsia we not infrequently see bleeding in and on the placenta. . . . To this may be added that bleedings in the inner organs in eclampsia are rather frequent. Liver, spleen, kidneys, brain are often found to be the site of ecchymoses or greater bleedings. Having now learned that bleedings are frequent in the muscle of the uterus, I think we are right in assuming that these bleedings may have the same cause as the others. And last of all, it is striking how often the general state of the patient in a case of accidental hæmorrhage resembles an intensive intoxication, as we see it in eclampsia. . . . But the other reasons I have mentioned speak very much in favor of the supposition that accidental hæmorrhage and eclampsia are genetically connected. The increased blood pressure, which is so common in eclampsia, may also be of some importance for the separation of the placenta. The albuminuria would thus only be a symptom of the general intoxication, which in one case causes eclampsia, in another case accidental hæmorrhage, in a third perhaps both of these diseases. But this does not, of course, give any explanation as to the origin of the accidental hæmorrhage. The problem will then form a part of the great problem of eclampsia or of the toxæmias of pregnancy. But the fact that two groups of symptoms, which we formerly took to be indicative of two different diseases, can be looked upon from a common point of view, seems to be an advantage."

Such are the grounds upon which uteroplacental apoplexy is tentatively related to eclampsia. Should this view of the matter prove to be correct, and should my own contention that the pathological picture points to the placenta as the source of the toxin, receive acceptance, we will have at least some evidence that a placental dysfunctioning is primarily responsible for the occurrence of both conditions. It does not seem entirely improbable that quantitative or qualitative variations in the toxic output of the placenta may well account for quite extreme variations in the resulting clinical picture.

In this connection, however, certain discrepancies must be noted. Thus eclampsia occurs with greater frequency in primiparæ than in multiparæ, where in this series only approximately 25 per cent were primiparæ. Furthermore, eclampsia exhibits no especial tendency to recur in subsequent pregnancies, whereas Couvelaire and others have remarked on the tendency of accidental hæmorrhage to recur, and a history of accidental hæmorrhage or toxæmia in a previous pregnancy was not infrequently noted in the cases in this series. This problem must be left to the future for solution.

RELATION BETWEEN UTEROPLACENTAL APOPLEXY AND ACCIDENTAL HÆMORRHAGE

The question naturally comes up: Are all cases of accidental hæmorrhage toxic in character? While not denying the possibility that traumatism may be an occasional factor in producing placental separation, I believe with Essen-Moeller that such cases are exceptional, and that the toxic cases predominate. In the present state of our knowledge we can only assume, reasoning from analogy with other conditions, that variations in the toxic qualities and amount of the toxin, and the duration of its excretion, may determine wide clinical and pathological differences. The presence of albuminuria in a large proportion of the cases of accidental hæmorrhage is significant. The rapidity with which the cases under discussion have been accumulating in the literature recently would seem to justify the conclusion that similar lesions, of a milder type, are undoubtedly present in many cases of accidental hæmorrhage which do not come to laparotomy or autopsy. Ahlström considers this point, and says: "I have collected, in addition to my 3 cases, 23 cases published since Couvelaire's paper in 1911, showing hæmorrhagic infiltration of the uterus, while at the same time I have found 15 cases in which the description was sufficiently clear, even when the point was not definitely mentioned, to justify the conclusion that no

infiltration was present." It is entirely possible to believe, however, that a careful microscopical examination of such uteri would demonstrate slight hæmorrhagic lesions in the decidua basalis or uterine wall. My own belief is that practically all cases of premature separation of the normally implanted placenta will ultimately prove to be caused by the same placental poisoning which in extreme cases produces the typical picture of fulminating uteroplacental apoplexy.

CLINICAL CONSIDERATIONS

As this paper is not concerned with the general subject of accidental hæmorrhage, it is necessary to take up here only the points on the clinical side on which light may have been thrown by the study of uteroplacental apoplexy.

Symptoms. With the exception of showing the symptoms of toxæmia to a more marked degree, the cases in this series have presented only the usual symptoms of accidental hæmorrhage, namely: sudden onset of constant abdominal pain, shock, external bleeding, ligneous consistency of the uterus, and acute anæmia. The occurrence of postpartum hæmorrhage in so many cases is very significant, indicating the disorganized state of the uterine wall and its inability to control hæmorrhage by the normal mechanism of retraction and contraction.

Diagnosis. The diagnosis of uteroplacental apoplexy can be definitely made only by direct inspection. It should be suspected in all the more serious cases of accidental hæmorrhage, and marked evidence of toxæmia, or severe postpartum hæmorrhage point strongly to its presence.

Prognosis. This is uniformly grave. The maternal mortality was 38 per cent in 50 cases diagnosed during life. The fœtal mortality was 92.5 per cent in 67 cases.

Treatment. Many practical applications of the various clinical and pathological data discussed above will immediately suggest themselves in connection with the subject of treatment. In the first place it must be borne in mind that all cases of accidental hæmorrhage are not necessarily critical. In some cases the bleeding is slight, the uterus gives little or no evidence of filling with blood or of interference with its function, and the constitutional symptoms are slight or entirely lacking. Here it is, of course, unwise to be stampeded into an unnecessary radicalism. Such cases are best left to the unaided efforts of nature. In the severe cases, especially where the evidence of toxæmia points to the serious involvement of the uterine wall, the situation is most critical, and an intelligent radicalism will probably in most cases prove to be most conservative. In such cases the points to be borne in mind are the damaged state of the uterine wall and the possibility of intra-abdominal and postpartum bleeding. When the condition of the cervix permits immediate vaginal delivery, this should be accomplished as promptly and conservatively as possible. In the management of the third stage the nicest judgment will be necessary. The first evidence of postpartum hæmorrhage should indicate the most thorough and immediate packing of the uterus. The occurrence of bleeding through the packing, or a progressive deterioration of the patient's general condition should be met by immediate abdominal hysterectomy.

In the severe cases occurring before or early in labor there can be no question that immediate operative intervention is urgently indicated. I have no hesitancy in saying that the abdominal route should always be selected and that vaginal hysterotomy has no legitimate place in meeting such a situation. The abdominal operation gives immediate control of the sources of the hæmorrhage and effects a non-traumatizing delivery at the same time. With the abdomen open and confronted by a typical case of uteroplacental apoplexy what course should be followed? Couvelaire held that a marked hæmorrhagic infiltration of the uterus always indicated a Porro operation. This contention has not been generally endorsed. The first step should look toward conservative cæsarean section. Every effort should then be made to make the uterus contract and if this can be satisfactorily accomplished it should be allowed to remain. It would seem reasonable to believe that the normal involutionary processes would cause rapid absorption of the hæmorrhagic effusion

and return the organ to a condition not incompatible with the performance of its functions in a subsequent pregnancy. If, on the other hand, a seriously damaged organ fails to control bleeding too much time should not be lost in the effort to make it do so, and it should be amputated supravaginally. Such a procedure might be properly undertaken on slighter indications in multiparæ than in primiparæ. The statistics of this series of cases, previously given, show that conservative cæsarean section offers the greatest hope for recovery. After giving due consideration to the fact that Porro operations were probably done in the worst cases, my impression is that the better results noted in the conservative operations were not entirely due to this cause.

CONCLUSIONS

My conclusions as a result of this study are as follows:

1. Uteroplacental apoplexy is caused by the inundation of the uterine wall with a toxin of the nature of a hæmorrhagin, liberated from the placenta, and, naturally, producing its maximum effect at the site of its absorption and greatest concentration.

2. Accidental hæmorrhage is probably, in the great majority of cases, a manifestation of the same process.

3. Clinically, the significant fact in the pathology is the damaged state of the uterine wall, which tends to cause both intra-abdominal and postpartum hæmorrhage.

4. In severe cases, with an undilated cervix, the most conservative treatment is abdominal cæsarean section, followed by hysterectomy, if indicated, in order to assure certain hemostasis.

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DEPARTMENT OF TECHNIQUE

SOME OBSERVATIONS UPON THE TREATMENT OF HIP-JOINT DISEASE

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THE establishment of a principle which invariably holds true in the treatment of disease is a difficult, if not impossible, attainment; but the exceptional opportunity for the study of hip-joint disease afforded at the Massachusetts Hospital School may serve to bind together some scattered facts for contemplation and lead to a more uniform and rational treatment of this affection.

The Massachusetts Hospital School is a public charitable institution for the care and education of the crippled and deformed children of the State and while it is maintained primarily as a school, it has hospital facilities and a resident medical staff. Covering the period of 13 years since the institution was established, nearly one thousand patients have been under treatment and of this number approximately one hundred and seventy-five children were suffering from hip-joint disease. In the vast majority of these cases, there was apparently no question as to diagnosis at the various hospitals in which previous treatment had been prescribed. In fact the symptoms have been exceedingly conspicuous in practically all the patients received at the State school. Extensive abscess formation has been by no means uncommon and many cases without open sinuses have been found to be rapidly advancing toward suppuration.

That there either had been doubt or uncertainty as to treatment or a wide range of opinion respecting the management of hip disease at various hospitals throughout the State was evident from the histories obtained and from the treatment previously advised. Children with some very acute hip conditions, with marked flexion and adduction deformity, have come in with only a pair of crutches as a means of obtaining relief, and others had been treated by the local application of liniments and physiological rest in bed. While a very few cases were admitted soon after the earliest appearance of symptoms and others had been given careful and consistent treatment by effective traction and immobilization, by far the largest number had been treated with plaster-of-Paris bandages applied in a variety of forms.

It has always been the policy of the institution to procure in all cases the fullest possible previous history obtainable from hospitals and surgeons by whom patients have been treated and, whenever practicable, to continue the treatment which had been prescribed. At first the previous treatment was followed for a few weeks at least, provided the patients had been recently under what was thought to be appropriate treatment; but it very soon became apparent that complete physical examinations upon entrance and the progress of the cases could not in this way be followed with the thoroughness which was essential in a State institution. Furthermore, when the removal of plaster-of-Paris bandages was delayed, it was often embarrassing to the administration to attempt to explain to the satisfaction of children's parents how and when abscesses had formed and atrophy and plaster sloughs occurred in parts which had appeared to them quite normal when last seen. For the above reasons rather than because of any prejudice for or against any particular method of treatment, it soon became the universal practice to remove every form of mechanical apparatus immediately upon the child's entrance to the school infirmary. Thorough physical examinations including X-rays were then made and the patients were put to bed under traction by means of weights and pulleys until the cases were reviewed by the staff or some member of the board of orthopedic consultants and the treatment to be followed agreed upon.

A few of the photographs taken upon admission will not only serve to illustrate some of the problems with which the Hospital School was confronted, but also show the woeful lack of uniformity with which cases of hip disease have been managed.

Figure 1 is that of a (6-year-old) boy upon admission 5 years after the onset of hip disease, for which no mechanical appliance had ever been prescribed. While nature's cure had resulted in some very unfortunate deformities and complete ankylosis of the joint, the next patient (Figures 2 and 3) was found to have deformities to an equally distressing degree after suffering for 3 years with the added burden of a series of plaster-of-Paris casts. The hip was still sensitive, the femoral head had been destroyed and the destructive process was still going on at a rapid pace. The conclusion may be drawn that the plaster bandages were not properly applied or that successive casts were not made by the same surgeons at out-patient clinics and that the treatment had not been consistently followed.

The patient shown in Figure 4 had been under plaster treatment for about 11 months and the last cast as shown in the picture had been applied just before admission. That the attempt at immobilization was not effective is shown by the space between the thigh and the plaster. Pain and adductor spasm were also prominent features.

The extent to which the soft tissues sometimes become involved may be seen in another case (Figures 5 and 6). This patient had been treated with successive plaster spicas for about 18 months. He was in extremely bad health and died shortly after admission. These few cases have been cited and many more could be added to prove why the plaster spica is not regarded with special favor at the Massachusetts Hospital School in which many terminal cases of hip-joint disease are received.

Some years ago the writer had occasion to consult Dr. Edward H. Bradford concerning the management of a very troublesome case of hip disease in a rapidly growing adolescent girl who had been sent to the State school as a last resort. A heavy, burdensome plaster spica was removed and the child relieved of a great deal of pain and made fairly comfortable in bed with the regulation weights and pulley traction. The consultant complimented the staff upon the skill with which the hip was being managed, position was good and the weights adequate; but he significantly remarked: "While the hip suggested that the child should be in bed, her face indicated that she should be up." Prolonged plaster treatment having failed, it was finally decided to employ the traction abduction splint which was designed by Dr. Bradford some years ago for use at the Boston Children's Hospital. The child's hip had been extremely painful for a long time, the prolonged suffering being expressed by her features in the clearest manner. The relief afforded by the bed traction was also given by the traction splint which, at the same time, did away with the necessity of greatly restricting the child's freedom. Her appetite improved from the first, she attended a short daily session of school and improvement to an eventual recovery was most gratifying. The merits of the Bradford abduction splint were sufficiently obvious in this case to justify its use in other cases until it gradually came to be regarded as indispensable to the welfare of many cases of hip disease seen at the Hospital School.

Contrary to the opinions of some to whom the advantages of the splint have been demonstrated, it is neither difficult to make and apply nor troublesome to keep effectively in place. How well the splint (Figure 7) is adapted by the abduction arm to hold the thigh in a position to be desired and to permit as much pull by means of the ratchet as may be necessary to overcome muscle spasm, is illustrated by Figure 8.

On February 3, 1914, a (9-year-old) boy was admitted to the school infirmary by transfer from one of the larger general hospitals in which a heavy plaster cast had been applied to his left hip-joint 3 months previously. In September, 1913, he had fallen from a fence; but no direct injury was suspected until 2 months later when he complained of pain and began to walk with a limp. He was taken to the hospital in November, the symptoms meantime gradually getting worse. A diagnosis of tuberculous disease of the joint was made, the regulation plaster cast put on, and he was kept under continuous observation as a house patient until he was discharged to the Massachusetts Hospital School. Upon removal of the plaster spica the superficial veins were observed to be much enlarged and, while there was no localized fluctuation, there was marked swelling about the thigh which extended into the foot. The hip was very painful with marked muscular spasm and the characteristic symptoms of moderate flexion and adduction deformity, but no apparent shortening. A positive von Pirquet test was obtained and a deep abscess formation shortly came to the surface in three discharging sinuses. The X-ray in this case showed roughening of the upper margin of the acetabulum and lower half of the surface of the femoral head.

This was thought to be a case in which the plaster spica should not be reapplied, neither did it seem advisable to keep the child long in bed and a Bradford abduction splint was accordingly

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 1. Six-year-old boy upon admission to hospital, 5 years after onset of hip disease. No mechanical appliances had been applied.

Figs. 2 and 3. Patient 3 years after onset of disease. Treated with a series of plaster-of-Paris casts.

Fig. 4. Patient had been under plaster treatment 11 months. Note space between thigh and cast.

made and worn for a period of about 2 years, as shown in Figure 9. Improvement was rapid, there was a steady gain in weight, the sinuses healed promptly, and with the aid of crutches and a high sole to enable the boy to swing the splint clear of the floor, he was able to get about and attend an open-air school. When the newly-formed hard tissues were thought to be firm enough to permit moderate weight-bearing, the traction straps were removed and the splint worn as a perineal crutch. In June, 1917, when the splint was removed altogether, an examination showed apparent recovery without shortening and with good motion in all directions. The boy continued to remain at the school for a few months until much of the atrophy which had taken place had been overcome and he was finally discharged in March, 1918, 4 years from the date of entrance. In order that there might be no doubt as to the permanency of the recovery, he was examined 2

Figs. 5 and 6. Showing extent to which soft tissue sometimes become involved. Patient treated with successive plaster casts for about 18 months.

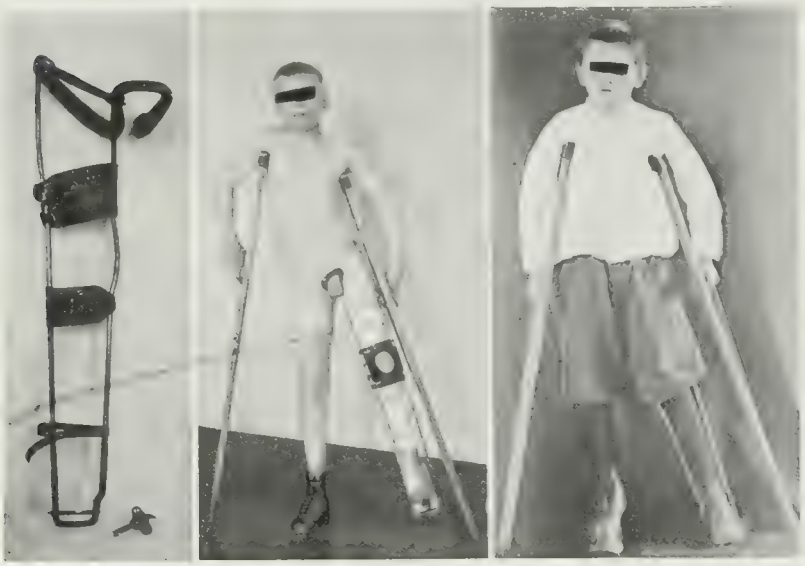

Fig. 7. Fig. 8. Fig. 9.

Fig. 7. Bradford traction abduction splint.

Fig. 8. Bradford splint applied showing how well it is adapted by abduction arm to hold the thigh in position desired and to permit as much pull by means of the ratchet as may be necessary to overcome muscle spasm.

Fig. 9. Another case in which the Bradford splint was applied and worn for a period of 2 years.

years later and the photographs (Figures 10, 11, and 12) taken for the completion of his case record.

Occasionally cases have been sent to the Hospital School very soon after the first appearance of hip disease and have been treated with the abduction splint from the first. Practically without exception these cases, as well as those few for whom the splint had been early prescribed elsewhere and who afterward came to the State

Figs. 10, 11, and 12. Photographs of patient shown in Figure 9, taken 2 years after discharged as cured.

school to have the same treatment continued, have made good recoveries with motion, which has not been found to be true in the much larger number of cases for whom plaster treatment had been long prescribed.

The question has sometimes been raised as to whether patients in whom almost perfect recovery had taken place were not suffering from some other affection than that of a tuberculous invasion of the joint. While it is doubtless true that some recovered cases were not tuberculous, there appears to be no doubt but that many of them were, and after all pathological refinements in diagnosis are not essential to the treatment of an acute destructive disease process in the bones of the hip-joint.

All the cases taken together and considered as a series or group, seem strongly to suggest that there is an opportunity for improvement in the management of the average run of cases of hip-joint disease. They certainly have given some important evidence of the value of the Bradford abduction hip splint and so favorably has it been regarded by those who have had an opportunity to become familiar with its use in caries of the hip-joint, that it has even been employed with marked success in the treatment of fractures of the neck of the femur.

THE CLINICAL ASPECT OF TENDON TRANSPOSITION

By M. A. BERNSTEIN, M.D., Chicago

In former publications[1] I have described a method of tendon transposition which was based upon animal experiments and upon a technique developed on cadavers. The method, in brief, consists in transposing a healthy tendon together with its sheath and peritendinous structures,[2] to replace a paralyzed one. In the lower portion of the peroneus longus muscle, a plastic is performed on the sheath to enclose the tendon at that point (Fig. 5). This paper deals with the clinical application of these principles, and a report of cases operated upon.

From studies of embryological specimens and anatomical dissections it is found that the tendon with its peritendinous structures comprises an integral unit. While the sheath is looked upon as a fluid buffer to protect the tendon from external violence and also as a medium through which the tendon can glide more easily, it serves a greater purpose surgically. It protects the tendon from traumatism in tendon transposition; it permits the peritendinous structures to bear the effects of accidents from infection; it preserves the blood supply and prevents the formation of adhesions directly to the tendon.

Embryologically there is an early differentiation of tendon and tendon synovia. Long before there is function in the tendon, the sheath is seen in the process of formation. This disproves the theory of Velpeau that function is necessary for its formation. Motion helps to develop, not to form, tendon synovia. While it is impossible to state that tendon synovia exists morphologically in the embryo of 2½ months, there is a definite development which indicates that the tendon sheath is in a stage of formation. The tendon synovial development begins as a rarefaction of the embryonal tissue about the tendon. When this is complete the cavity is formed. Lowell and Tanner state: "Histologically the tendon is originally embedded in a homogeneous tissue in which the fibrous canals are seen as dense tracts. The embedding tissue takes on a mucous character and gives place to the first synovia." My deductions are as follows: The tendon, or rather what will eventually become tendon tissue, is seen as a thin, homogeneous ring. This ring or half ring has no definite relation to the tendon, and is irregular in outline (Fig. 1). However, it can be seen that this ring consists of two layers, an inner and an outer, and corresponds to the parietal and visceral layers of the fully developed tendon sheath. The tendon sheath soon approximates itself and surrounds the tendon on all of its sides. Cleavage takes place in both layers on the mesial side of the tendon, with the formation of mesotendons (Fig. 2). When a fully developed tendon is lifted out of its sheath it is found attached to the floor of the sheath by means of these mesi. Above the level of the sheath a special arrangement can be seen. Lowell and Tanner say that at the muscular tendinous junction there appears a reflection of a specialized portion of the perimesium. This is composed of areolar connective tissue and is attached to the tendon and the sheath and becomes continuous with the peritendineum externum. A fold is formed which allows for contraction and relaxation of the tendon. This fold or reflection prevents rupture of the sheath at that point during the phase of contraction. It is claimed that the gliding of the tendon is dependent upon this special arrangement. This structure must, therefore, be preserved when the tendon is transposed.

I shall not go into further detail of tendon anatomy since it can be found described in articles by Biesalski and Mayer, Lowell and Tanner, Steindler, and others. Suffice it to say that a clear conception of the anatomical relations, and of the physiological functions of these structures is necessary, if a functional result is to be expected from tendon transposition.

The older methods of tendon transposition, namely the anatomical transpositions of Nicoladini, and the direct implantation method of Lange and Drobnik and their various imitators, did not take into account the physiological relations of the tendon to its peritendinous structures. These methods emphasized the position of the transposed tendon, its exact mode of implantation or insertion, and the technical details of suture. Little or no attention was given to the tendon itself or to the conditions which influence its function. The effects of surgical trauma were ignored. The fundamental physiological conditions upon which the gliding and nutriment of a tendon depend did not receive proper recognition in practical surgery. The value of physiolog-

[1] Surg. Clin. Chicago, 1918, Oct.; Surg., Gynec. & Obst., 1920, xxix, 55.

[2] Peritendinous structures comprise the sheath, mesotendon, paratenon, and all the structures which surround the tendon.

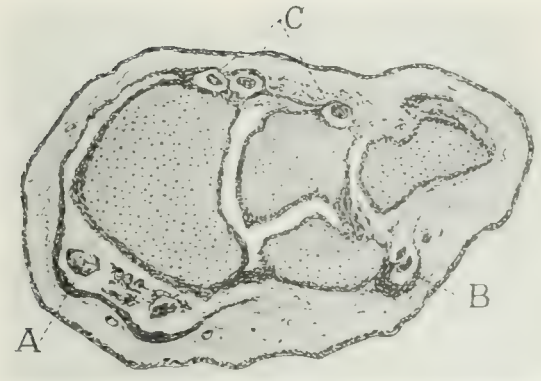

Fig. 1. Cross section of ankle of fœtus 3 months old. *a*, Flexor group of muscles; *b*, peroneus group; *c*, anterior tibial group. Note the development of the sheath at *b*. There is as yet no differentiation of sheath from the surrounding tissue, but there is evidence of its formation from the cell grouping.

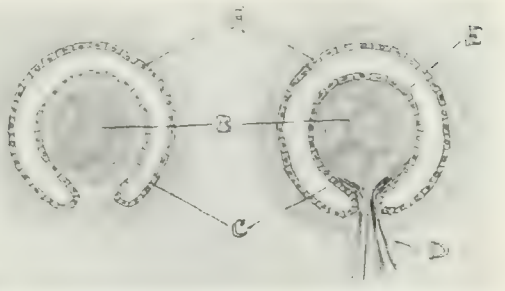

Fig. 2. Schematic illustration of the development of the tendon sheath. *a*, Outer sheath wall; *b*, tendon; *c*, cavity of the sheath; *d*, mesotenon; *e*, peritendonium externum (epitenon).

ical transposition has, however, been recently recognized. Biesalski and Mayer have clearly seen its importance, although in their technique some of the anatomical peritendinous structures are destroyed. Mayer's method consists in removing the tendon from its surroundings and from the tendon sheath, and transposing it through the sheath of the paralyzed tendon. His criticism of my method is that it is limited in its application, and that it is impossible to transpose the peroneus longus with its sheath, because the sheath does not completely surround the tendon at the external malleolus, so that a considerable portion of the tendon is deprived of tendon sheath. The criticisms advanced by him are not well founded, because I have transposed the principal tendons without difficulty, and as for the peroneus longus transposition it can be seen that the sheath is transposed without great difficulty.

Steindler fully recognizes the necessity for a biological transposition and while avowedly following the method of Biesalski and Mayer, insists upon the necessity of supplementing it by the preservation of the mesotenon in order to insure the vitality of the transposed tendon and prevent its fibrosis. He states that when he reoperated upon a case for which a tendon transposition was done by the old method of tendon stripping he found "that while they (the tendons) had not torn loose from their attachment they had degenerated into fine and insignificant bundles of a few fibers stretching out and utterly incapable of producing any mechanical action." It would be interesting to know what his findings would be in the cases operated upon by his modification. I had occasion to re-operate upon two of my cases, one because the tendon was too long and exercised no movement of the joint although it could be seen to contract; the other because the tendon became loosened from its attachment as a result of liquefaction necrosis and became attached to the subcutaneous tissue. The tendons were easily isolated from the surrounding tissue and appeared normal. A section of tendon was removed for microscopic study and showed no change whatever.

Bunnell also recognizes the necessity of preserving and removing the tendon with the intact peritendinous structures. He has done complete tendon transplantations in the hand. Unfortunately, the end-results of complete tendon transplantation, especially in the hands and fingers, are not as satisfactory as we hope to see accomplished in the future.

The methods of practical tendon transposition followed up to the present time have not accomplished the satisfactory results which were claimed for them. While these procedures could be relied upon as practicable, yet the functional results were generally poor, and a surgeon could not be assured that after the most careful technique and operative care the functional end for which the operation was performed, would be effected. The whole *raison d'être* of the operation, namely, the substitution of a functioning tendon for a paralyzed one, generally failed in practice.

The reasons why tendon transposition failed were that the tendon became fibrous; adhesions formed between the tendon and the tissue surrounding it in its new position; that bony structural changes in the joints were not corrected, and that poor tendons were used to replace paralyzed ones. The histological findings in specimens removed when a tendon was trans-

Fig. 3. Incision for transposition of the peroneus longus muscle.

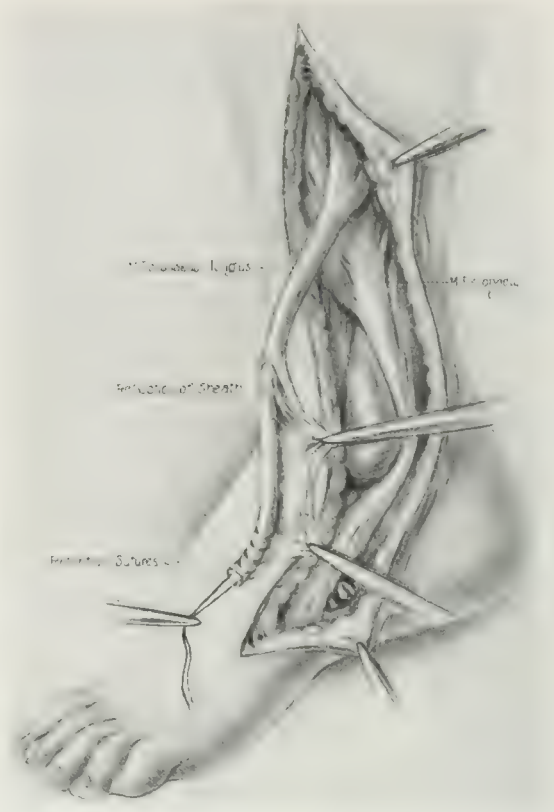

Fig. 4. Peroneus longus tendon dissected out with its sheath. Fixation sutures in place. Notice the amount of free sheath flap carried over with the tendon.

posed by the older methods, show that the proliferative and infiltrative changes seriously interfere with function. Even when the tendon is transposed through the sheath of another tendon, there follows a traumatic inflammatory reaction with organization of the exudate. This exudate resembles that of a tenovaginitis, and adhesions are likely to follow as a result of insufficient absorption. It is, therefore, clearly evident that when a tendon is transposed together with the sheath and peritendinous structures, there is no reaction between the tendon and the sheath and no opportunity for adhesions to form directly to the tendon. When adhesions do form they are to the peritendinous structures and do not interfere with the gliding mechanism. Since the blood supply is not materially interfered with by preservation of the mesotenon, there is no atrophy or fibrosis of the tendon. The histological results fully justify the transposition of a tendon together with its sheath and therefore this operation may be considered a true physiological method of tendon transposition.

Whatever method is employed there are certain practical points to be considered: The tendons to be transposed must be strong enough to perform the work imposed upon them. A muscle that has been involved in the acute stage of poliomyelitis and has not fully recovered its strength is not fit for transposition. The use of such material is one of the most frequent causes for failure. It is not to be expected that a muscle which functioned poorly in its original position will work better when transposed, when it may have to assume still greater obligations.

The proper length of a muscle must be provided to give optimum conditions for contraction. Often a transposed muscle is seen to contract, and yet it produces no movement of the joint. This is usually due to too much play. It takes very little slack in a muscle to produce interference with function. I should prefer to suture a

Fig. 5. Method of closing the sheath. The suture material used is fine catgut.

Fig. 6. *A*, The peroneus longus tendon is ready to be drawn to the inner side of the foot to the insertion of the tibialis anticus muscle insertion. *a*, Shows the method of splitting the tibialis anticus tendon at its insertion to receive the transposed tendon. The suture goes through the tendon and periosteum of the first cuneiform bone. *B*, Shows the transposed tendon in place. The forceps are upon the retracted tibialis anticus tendon.

tendon under a little tension rather than to leave it too long. A taut muscle can be relieved by overcorrecting the joint.

We often pronounce muscles permanently paralyzed and subject the patient indefinitely to the wearing of braces or of casts, and the result is muscle inactivity, arrest of active circulation, and consequently a thin, shrunken extremity. One must always bear in mind that there is a limit to conservative treatment and plan operative procedures for ultimate correction. When a tendon transposition has been done and the result is a failure, it is because the surgeon has used bad judgment in selecting his case. Merely because an extremity is disabled as a result of poliomyelitis is no indication that tendon transposition will be of benefit. One must study the individual case to determine which muscles are paralyzed and which ones have been spared. The operation of tendon transposition should not be made to fit the case but the case selected to fit the operation. Often an apparently paralyzed muscle can be made to function when a healthy muscle is joined adjacent to its point of insertion. To illustrate, the tibialis anticus muscle may have lost its function, but the extensor proprius muscle is active, and when transposed to the insertion of the tibialis anticus, the latter is stimulated to contractility due to the contraction of the former. This phenomenon can be explained in this manner: first, the relaxed and stretched tibialis anticus is given an opportunity to contract, this being accomplished by taking up the slack of relaxation, as pointed out by Sir Robert Jones; and second, the muscle is permitted to take part in the contraction of the transposed muscle, and is thereby re-educated to contractility. This phase corresponds to the muscle training of Robert Lovett, but in this

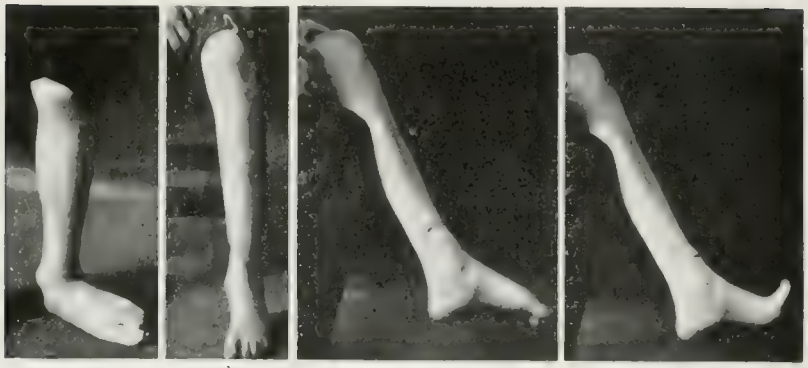

Fig. 7. *a*, Paralysis of the anterior tibial muscle and to some extent of the extensor proprius hallucis. Taken before operation. There was inability to dorsiflex and abduct the foot.

b, Position of the foot 2 years after operation. The peroneus longus was transposed together with the peritendinous structures to replace the tibialis anticus. Notice the stability of the foot and the amount of abduction.

c, Showing the amount of plantar flexion.

d, Showing the amount of dorsiflexion of the foot.

instance the transposed muscle trains the paralyzed one.

Fig. 8. No picture was taken of this foot before operation. There was a paralysis of the tibialis anticus but the extensor of the large toe was in good condition. The patient walked with a valgus deformity and was unable to abduct the foot. The extensor longus hallucis was transposed to the insertion of the tibialis anticus. Notice the amount of dorsiflexion of the foot. Note also that the extensor function to the great toe is not destroyed. This was accomplished by suturing the cut stump of the extensor proprius hallucis to the common extensors of the toes. This photograph was taken 2 years after operation.

The lower picture shows the amount of plantar flexion.

Case 1. This patient was 9 years of age when I first saw him (Fig. 3). He had a typical attack of acute poliomyelitis when he was 3 years of age. Treatment as carried out by a practitioner consisted of electrical stimulation, massage, etc. The ultimate result was a paralysis of his anterior leg muscles, namely, tibialis anticus, extensor proprius hallucis, and to some extent the extensor communis digitorum. He wore a brace to correct the resulting valgus deformity, but the correction was not accomplished. I removed the brace, and for many months thereafter treated each muscle with mild applications of the faradic and galvanic current and muscle training. There was no response from the stimulation and the muscles regained no strength. He was operated upon at Michael Reese Hospital 3 years ago. The peroneus longus was transposed together with its sheath and inserted into the split tibialis anticus at its point of insertion subperiosteally into the base of the first metatarsal bone. The technique employed may be described as follows:

Operation. An incision is made beginning at the upper outer third of the leg over the course of the peroneus longus muscle and extending downward, curving around and beneath the external malleolus to about the peroneal tubercle on the outer side of the foot (Fig. 3). The knife is changed, and the skin edges are protected. The peroneus longus is exposed, and the deep fascia carefully dissected away. The tendon of the peroneus longus is isolated at the lower end of the incision where it passes to the plantar surface of the foot, and is severed. Retention sutures are introduced, and the tendon is gently

Fig. 9. *a* (at left), Paralysis of peronei muscles. Patient had poliomyelitis when a child, is now 20. She is unable to abduct the foot.

b, Three years after operation. The extensor proprius hallucis was transposed to the outer side of the foot to the insertion of the peroneus tertius. Notice wrinkling of skin over the contracted tendon.

Fig. 10. *a* (at left), This photograph is a pose endeavoring to simulate the position of the feet before operation. The patient had poliomyelitis when 10 years of age. She is now 26. She wore braces on both legs and used crutches, walking with great difficulty. In her case the peronei were paralyzed and there was very little power in the anterior muscles from contraction.

b, The tendo achillis was split and detached from the outer surface of its attachment following somewhat the original Nicoladini operation and sutured to the peroneus longus, after the method of Vulpius. Operation performed in April, 1913.

lifted out of its bed. The suture material used for the fixation is kangaroo tendon. The method of inserting the suture must be such as not to constrict the tendon bundles. I have, therefore, employed a method which I call the "herring-bone stitch" (Fig. 6, *b*). (I have found that by using silk a considerable amount of constriction is produced which causes pressure necrosis with liquefaction of the tendon at the point of insertion. This is discovered about the tenth day after the operation and is shown by the discharge of a serous exudate which resembles infectious material. It is needless to say that the occurrence of such an accident is detrimental to the entire operative procedure, since the tendon is entirely loosened from its periosteal moorings and assumes a subcutaneous fixation.) The tendon is now removed from its surrounding tissue by means of a scissors, taking with it as much of the peritendinous structures as possible. When the external malleolus is reached it is found that the peroneus longus and brevis occupy the same synovial compartment, and that the two are intimately connected for about an inch and a quarter. The roof of the canal is now cut. This corresponds to the lateral ligament of the ankle-joint and fascia cruris and, therefore, must be respected. The tendon is delivered from this canal and is found attached to the floor by means of the mesotendon which at this point is about 6 centimeters in length. This is cut as low down and as far away from the tendon as possible, and releases the tendon to the point where it is surrounded by its own sheath (Fig. 4). The tendon with its sheath is isolated to beyond the musculotendinous junction. This is done to assure direct muscular pull. A plastic is performed upon the lower portion of the sheath (Fig. 5). This is done in the following manner (I wish to call special attention to this part of the operation since I have received numerous inquiries to clarify this step):

Two Allis forceps are placed upon the free flap and the flap stretched out. Great care must be exercised in doing this since this part of the sheath is veil-like and tears very easily. The flap is brought over so that it surrounds the tendon and is sewed by means of fine catgut threaded in a cambric needle (Fig. 5). The sheath now surrounds the tendon on all of its sides, leaving only a small portion of the tendon exposed at the point for insertion.

A tunnel is made by passing a large veterinary eye probe downward and inward along the course of the tibialis anticus muscle, forcing it down to the point of insertion of that tendon. A curved incision is made over the tip of the probe which corresponds to the insertion of the tibialis anti-

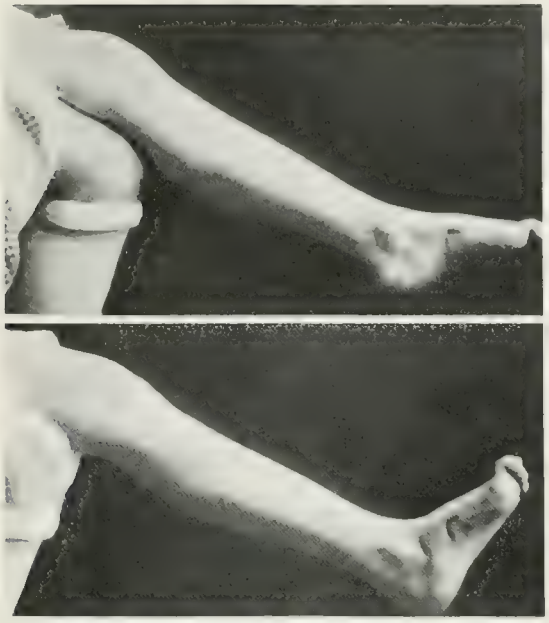

Fig. 11. *a* (above), Girl, age 21, had poliomyelitis when a child. This resulted in a paralysis of the anterior tibial and the extensor muscles of the thigh. Function returned in the extensors of the thigh as seen by the ability of the patient to extend her leg. The extensor longus hallucis muscle was spastic so that the large toe was overextended and rubbed on the under surface of the shoe. A physician amputated the large toe to relieve the contraction. Fortunately, the first phalanx only was removed. The operation performed in this case, May, 1920, consisted of transposing the extensor longus hallucis to the insertion of the paralyzed tibialis anticus. Point of insertion can be seen inside of foot. The proximal phalanx of the large toe was brought down and a fascial flap inserted between the articulation, the distal portion of the extensor longus hallucis was sutured to the common extensor so that patient now has a fairly useful large toe. An arthrodesis was performed between the calcaneoschaphoid bones, to give the foot more stability.

cus muscle, and the tip of the probe is delivered. The two ends of the probe are seized and moved from side to side so that the width of the canal is increased. It is necessary to incise the fascial planes at the point of entrance of the transposed tendon so that the tendon will not become strangulated (Fig. 6, *A*). The probe is threaded by means of the kangaroo fixation suture and is pulled down. The tendon is steadied and prevented from twisting, and brought out at the lower point of the incision.

The tendon does not pass superficially beneath the skin, but is found to pass beneath the annular ligament. The tendon is fixed to its new position as (Fig. 6, *B*). It is advisable not to constrict the tendon at this point by placing too many fixation sutures because of pressure necrosis. The skin is closed with catgut and a circular cast applied, extending from above the knee and including the toes. Returning now to the long posterior incision, the cut lateral ligament is sutured by a continuous fine kangaroo tendon. Care must be taken to suture the structures around the external malleolus very carefully so that the integrity of the joint is not destroyed. The cast is retained for 6 weeks, when it is entirely removed and active and passive motion carried out for 10 days, when walking is permitted. At the end of this time there is a physiological fixation of the tendon to its new point of insertion, and one is perfectly safe in permitting the use of the foot.

In every case of poliomyelitis there is some shortening of the extremity, and it is necessary to have a properly fitted shoe with an insole padded to compensate for the loss in length of the leg.

CONCLUSIONS

Tendon transplantation has a definite indication in the operative treatment of anterior poliomyelitis. If the results obtained are not satisfactory, the indications in a broad sense were not well defined.

Tendons should be transposed from the same plane when possible. When transposed from an opposite group, muscle training must be carried out, over longer periods.

Tendons must be transposed with their sheath and peritenous structures so that the vitality of the tendon is not interfered with.

When a tendon is transposed with its sheath adhesions are not likely to occur.

The operation must be carried out with care, avoiding trauma, exposure of the tendon to the air, and with as little handling as possible.

A MAMMOTH OVARIAN TUMOR

By JAMES W. WARD, M.D., San Francisco

MRS. J. F., age 47, first came under my observation in 1890, when I was called to attend her during an attack of peritonitis, which appeared in some way to be related to an ovarian cyst of moderate size. The patient's symptoms were abdominal pain and tenderness, vomiting, fever, and abdominal distention.

From this attack, she made a prompt recovery, and was not again ill with a similar condition until 1893. The abdominal distention had then increased, although she stated that she had enjoyed splendid health during the interval. Because of the history, I advised surgical interference, which, however, was emphatically declined.

I was not called again until the summer of 1907, some 14 years later, when I found her in a most deplorable condition. The tumor had attained tremendous size, and now caused almost constant pain and suffering. She had been confined for some time to her bed, although until fall she had been able to be about her room at least a part of the time. Before that time, she had been able to get about in a specially built low phaeton, the seat of which she filled completely.

Her history, save as reported above, was practically negative. She was of American birth. Her mother died when 60 years of age, from pneumonia; her father, at 76, from an unknown cause. Nothing was known of grandparents, collaterals, nor of a brother and sister. She had never suffered from serious diseases, save as outlined in the history of present condition. Her habits have been good. Menstruation began when she was 13, have been regular, every 28 days, and normal until patient was 45, when the flow ceased. She is the mother of three children, and her pregnancies have been without complications as have labor and the puerperium.

Physical examination. December 17, 1907. The patient has an anxious expression and a staring look. She has worn glasses for the last 3 years. The head is negative, save for many bad teeth. The neck is emaciated, without any palpable glands. The chest is symmetrical in its upper half. The lower portion is distended because of the enormous abdominal tumor, and the lower ribs are markedly everted. The breasts are atrophied. Breathing is rapid and labored. The heart is crowded upward by the tumor, and the apex is displaced into the axilla. The sounds are feeble and not clear.

The abdomen is tremendously distended by an enormous barrel-shaped tumor which completely fills the abdomen, everts the ribs, hangs far over the sides of the back, and extends downward nearly to the knees. Large veins like whipcords lie over the anterior surface. From pubis to xiphoid, the distance is 4 feet, 4 inches. From pubis to the most dependent part of the tumor is 32 inches. The girth at the umbilicus is 6 feet, 10 inches. The abdominal distention is so great that she lies in a semi-recumbent position so that part of the tumor's weight may be carried upon her legs. Quite naturally, neither the liver nor spleen could be palpated.

The anterior thighs are covered by the tumor. An extensive tense œdema involves both limbs from the iliac regions and buttocks downward.

The reflexes are present and normal in the triceps and wrist. They are not obtainable in the lower limbs because of the œdema and immobility due to the weight of the tumor.

By vaginal examination, the uterus is found crowded to the floor of the pelvis, otherwise it appears normal. The pelvic floor is weakened with a cystocele and rectocele. On rectal examination, the tumor is felt crowding down the pouch of Douglas.

The blood is negative save for a well-marked secondary anæmia. The urine is negative, although the specific gravity is only 1,006.

The patient's general condition is not good. She is weak and cachectic. There is tremendous abdominal distention. After 17 years of urging, she finally consents to operation for relief from suffering, with a very bad prognosis given to the family.

Operation. December 17, 1907, at Hahnemann Hospital in the presence of a large audience of invited physicians. As will be seen from the accompanying photograph, the patient completely filled two operating tables placed side by side. She was placed upon her side and the tumor was supported by the second operating table. The tremendous œdema present in the legs is clearly seen in the photograph. After careful abdominal preparation, a trocar was inserted and 24 gallons of a dark syrupy fluid, colloid in character, was removed. After a mid-line incision, the tumor was found to be adherent to the peritoneum. The adhesions were extremely dense and the sac was freed with the very greatest difficulty since it was adherent to the peritoneum throughout, to the liver, the gall-bladder, the spleen, and the intestinal coils.

The tumor arose in the right ovary and was a multilocular cystoma. The fluid in the various compartments was of different colors, black prevailing, and varied in consistency, although the average specific gravity was 1,040. Inspection of the enormous sac showed here and there areas of cystic hæmorrhage. There were no papillomata, although some of the partitions presented evidence of rupture.

The liquid and semifluid contents weighed 202 pounds; the sac weighed 19 pounds, 12 ounces—a total weight of 221 pounds, 12 ounces. The patient weighed just before operation 309½ pounds, so that the patient's net weight devoid of her tumor was 87 pounds, 12 ounces.

She survived the operation less than 1 hour.

A casual review of the literature supports the belief that this tumor is the largest yet reported. Gould and Pyle in their extensive compilation of unusual cases in medicine mention none larger than 182 pounds (Reifenyden's case) while all the others are 150 pounds or less. The texts usually state that the size of the growths is limited only by the distensibility of the abdomen and the resistance of the patient and some (as Penrose) mention without reference that cases attaining a weight of 200 pounds have been recorded.

A careful review, however, reveals five cases 225 pounds or larger, viz.: Binkley 225 pounds, Tuffier 235 pounds, Bullitt 245 pounds, Barlower 298 pounds, and finally Spohn's remarkable case

Photograph of patient lying upon operating table and tumor supported on second table.

in which he estimated the weight of the tumor at 328 pounds. Four other cases of more than 200 pounds are recorded, 29 weigh more than 150 pounds, 78 more than 100 pounds, 191 more than 60 pounds.

Two methods of arriving at the weights of the tumors have been used, yet both are subject to certain inaccuracies. The first adds the weight of fluid removed to that of the sac and when accurately controlled as in our case, is probably perfectly reliable. Yet fluid may be lost at operation, when the exact amount is difficult to determine. In other cases, as Spohn's and Barlowe's, the patients were tapped one or more times before the final removal of the tumor and the amount of fluid due to reaccumulation is of course unknown. Peaslee considers 2 pounds a day a very rapid rate of reaccumulation yet the question is so complex that it is hard to settle. In many of the older cases, which were merely tapped, the weight of the fluid only could be obtained and we must either accept the author's estimate or ignore the weight of the sac, which may be considerable, even up to 50 pounds.

The other commonly used method subtracts the weight of the patient after operation from her weight previous to it. It is, however, rarely possible to weigh a patient immediately after operation, and at a later time her loss in weight from œdema, or her gain in weight from improved nutrition, are factors that must be considered, though fortunately they often counterbalance each other. Ascitic fluid occurs so rarely that it ordinarily need not be considered. Twenty-five pounds, however, would probably be a very liberal estimate of the error by any of these methods of determination and this is a small factor when we consider the enormous weight of the larger tumors.

Of great interest is the fact that, in spite of the progress of modern surgery, 25, or nearly one-third of the total number of cases of more than 100 pounds have been reported within the last 20 years. It may be that the greater rarity of larger tumors prompts us to record a larger proportion of such growths. Yet Spohn's 328-pound case, reported from Texas in 1905, would have been remarkable enough to report in any age, as would Tuffier's 94-liter case, published in 1906, or Pfachler's 97-kilogram growth in 1904, since Peaslee in his monograph of "Ovarian Tumors" in 1872 states: "The largest amount of fluid in an ovarian tumor which has been recorded is 160 pounds, which was drawn off during an operation of ovariotomy by Kimball, more than 20 pounds being still left as he could not complete the operation." Emmett, in 1879, stated, moreover, that "Dr. Keith had removed a tumor weighing 120 pounds, the largest ovarian tumor ever removed successfully from the living body." Nor, as we might suppose, do all the present day cases come from remote districts, since Smith's 192-pound case reported in 1906 had received electricity and Christian Science treatment in Boston, for 2 years prior to her operation. Franz's 160-pound case operation in 1916 lived for years almost in the shadow of one of the larger Berlin hospitals.

As long as people live in superstitious fear of surgery or fall into the hands of charlatans for treatment, these very large tumors will occasionally arise.

TECHNIQUE OF RADIUM TREATMENT OF CANCER OF THE PROSTATE AND SEMINAL VESICLES

By HUGH H. YOUNG, M.D., F.A.C.S., Baltimore
From the James Buchanan Brady Urological Institute, Johns Hopkins Hospital

At the International Medical Congress, London, 1913, in the Section of Urology, Pasteau and Degrais presented a method for the treatment of cancer of the prostate with radium. The technique consisted simply in introducing a silver tube containing radium to which was attached a long wire which was employed to introduce the radium into the catheter to the proper distance, into the urethra, where it was left in place for an appropriate length of time. In Figure 1 the catheter with radium in place is shown schematically. Being impressed with the good results which Pasteau had secured in two cases by this extremely crude apparatus, I secured 102 milligrams of radium element in a glass tube and set about to construct more accurate instruments for the introduction of radium into the urethra, prostate, and rectum. The first instruments employed were provided with a straight cystoscope, the same cystoscope which I had used for several years in the construction of my cystoscopic rongeur (Fig. 2). With this cystoscope as a basis, the instrument shown in Figure 3 was made, and it at once became possible to introduce radium not only into the urethra and rectum, but into the bladder where, under cystoscopic direction, it could be applied to the region desired. It became evident at once that some means of firmly fixing and holding the instrument containing the radium was necessary in order to keep the application against the desired area for the entire period of treatment. Casting about for an instrument, I made use of the cystoscopic clamp or artificial hand which I had employed for several years to hold a photographic cystoscope in place during exposure of the plates. A ball of appropriate size was then placed around the shaft of the radium applicator which, when firmly grasped by the cystoscopic clamp, held the radium instrument in its grasp upon the desired spot. The completed instrument is shown in Figures 3 and 4. This then was the basis for a series of instruments which have since been constructed, the object of which has been to place radium upon a certain spot under the direction of either the cystoscope in the bladder or a finger in the rectum and to hold it there during the entire treatment seance.

It soon became evident that it was not necessary to use the cystoscope for applications of radium in the urethra or at the vesical orifice or even against the trigone, as it is easily possible by simple manipulation to determine where the instrument is in its relation to the vesical neck or to place the radium exactly where it is desired and then hold it there with the clamp. For the rectum the cystoscopic instrument was manifestly not necessary as the radium containing beak could easily be placed at the desired spot along the posterior surface of the prostate or vesicles or along the pelvic wall and held there by the clamp. We, therefore, constructed instruments of appropriate form not containing cystoscopes for treatment through the rectum, urethra, at the vesical neck or through the trigone and base of the bladder to the region of the seminal vesicles.

Figure 5 shows the present form of instrument which is employed for these treatments. The radium is contained in a small platinum tube which is surrounded by a metal cap covered with hard rubber, thus affording screening for both the α- and β-rays, and also the secondary rays. The ball is placed at the end of the rod thus facilitating usage in both rectum, urethra, and bladder, the small handle at right angles to the shaft facilitates operation, and indicates the direction of the beak.

Recently since the introduction by Barringer of the needling method for the treatment of carcinoma of the prostate through the perineum, I have made up in the workshop of the Brady Urological Institute an instrument which contains within the beak four needle points each containing 12½ milligrams of radium surrounded by a cap of silver which is surrounded by gutta percha. This instrument was supplied to and is in use by Dr. John H. Cunningham of Boston. Figure 6, *b* shows the needle with shaft attached for insertion through the perineum.

TECHNIQUE EMPLOYED

In the preliminary study of the cases a careful diagram showing the size and consistence of the prostate is made, utilizing a rubber stamp outline of normal prostate and vesicles as a basis. In making the examination with the finger of the left hand, the outline chart is drawn simultaneously, careful attention being made to get an accurate reproduction of the size and induration of the

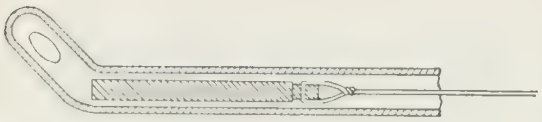

Fig. 1. Catheter method of Pasteau and Degrais for applying radium in cancer of the bladder and prostate.

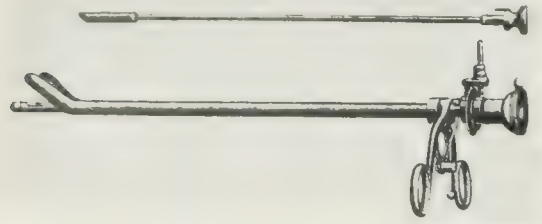

Fig. 2. Author's cystoscopic rongeur for obtaining sections of vesical tumors for microscopic study.

Fig. 3. Author's cystoscopic radium instrument 1 carrying a tube of radium in fenestrated platinum capsule in beak; closed with obturator.

Fig. 4. Instrument 1 with straight cystoscope introduced.

Fig. 5. Rectal radium carrier, applied under direction of index finger in rectum, and held in place by mechanical hand or clamp.

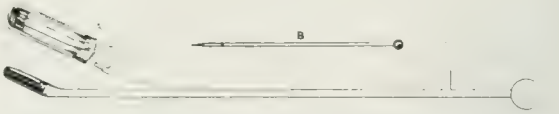

Fig. 6. New radium applicator with enlarged cap, *a*, made to contain four needles containing 12½ milligrams of radium each, which may be used also for needling through the perineum by means of attachable shaft, *b*.

mass. The degree of induration is indicated on a scale of four, blank being normal, parallel lines, slight induration; cross lines moderate induration, and additional cross lines (at 45° to the other two parallel lines) great induration, such as is characteristic of carcinoma. A typical chart of carcinoma of the prostate and seminal vesicles is shown in Figure 7.

If the diagnosis is clear from the extreme induration of a portion of the prostate and the absence of calculus from the X-ray examination, a cystoscopic examination may not be carried out. As a rule cystoscopy is much more painful in cases of carcinoma than in cases of hypertrophy, and if it is not necessary for diagnosis we usually do not insist on cystoscopy. If there is a question as to the diagnosis, cystoscopy is performed and is of diagnostic importance, first, because in cases where hypertrophy is present, the prostatic orifice usually shows no intravesical lobes or enlargement more than a small median bar or minute rounded lobe, and, second, because there is shown by examining with the finger in the rectum and cystoscope in the urethra a marked increase in the suburethral portion of the prostate, not merely in the prespermatic or subcervical group of glands, but also beneath the entire prostatic urethra from the vesical orifice to the apex, and this increase in the suburethral portion of the prostate is usually associated with marked induration. This is based on the pathological fact that prostatic hypertrophy almost never involves the so-called posterior lobe which lies between the posterior capsule and the ejaculatory ducts above and the lower portion of the prostatic urethra below, and that the same region is strangely the point of predilection for carcinoma. This diagnostic sign was first pointed out by me 16 years ago, and has been of great value in the diagnosis of early and doubtful cases.

The diagnosis of carcinoma having been made, the question arises as to whether a radical operation can be carried out with the probability of success. We have now had sixteen cases in which we have carried out our radical technique, and are able to report over 50 per cent apparent cures followed over a period of 5 years or more, and in the last four cases by a modification of technique, through which the preprostatic vessels, nerves, and fascia are preserved intact, complete urinary continence has been obtained.

Experience has shown that in cases in which the carcinoma is confined well within the capsule of the prostate, in which it has involved only the

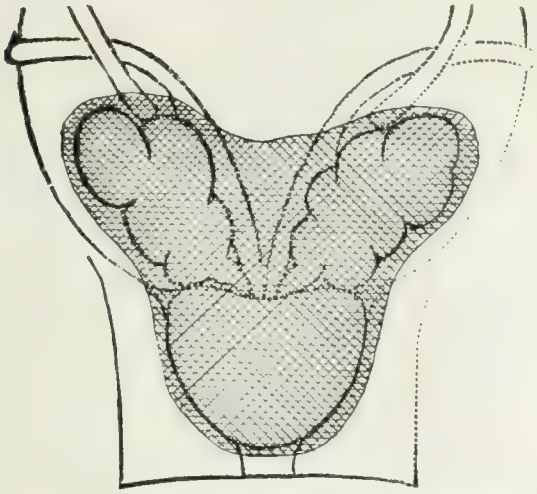

Fig. 7. A typical chart of carcinoma of prostate and seminal vesicles.

lower portion of one or both seminal vesicles, and in which it has not penetrated the prostatic capsule or fascia of Denonvilliers which covers not only the prostate but the seminal vesicles, the radical technique can be carried out with strong probability of a complete cure and a good functioning bladder with perfect control and without urethral stricture at the site of anastomosis.

Unfortunately, the great majority of cases present themselves much too late, the disease has already progressed well up along the sides of the seminal vesicles, and frequently involves the lower pelvic glands, only forming a plateau of marked induration above the prostate in the intervesicular region. In many of these cases there is no marked urinary disturbance beyond a slight residual and some increased frequency, owing to the fact that carcinoma of the prostate tends to invade the structures above, behind the bladder, and does not penetrate or ulcerate until later into the urethra or bladder. On this account operative relief for the obstruction is usually not necessary, and one is free to choose methods of attack upon the carcinoma which is usually producing symptoms due to its size and pressure upon nerves and adjacent structures. The plan of procedure for thorough treatment with radium which was first proposed by me before the American Urological Association at its meeting in Baltimore, 1915, and subsequently presented in a paper(1) has been carried out in over one hundred cases, the results of which will be presented in an accompanying paper by Dr. Clyde L. Deming, resident urologist of the Brady Urological Institute.

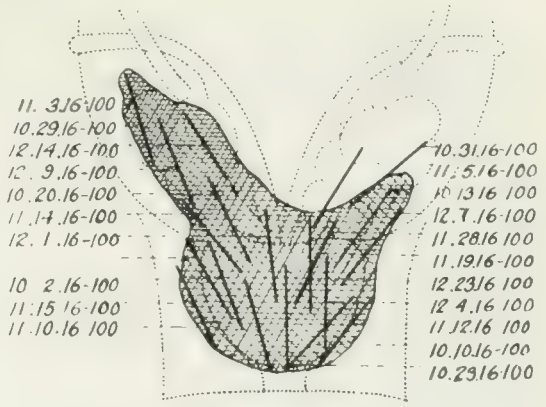

Fig. 8. A case of cancer of the prostate and left seminal vesicle (right vesicle slightly involved). The radium treatments, each representing 100 milligram hours, are shown and date of each is recorded.

In my first paper, Figures 8 and 9, the charts of cases were presented in which 100 milligrams of radium was applied for one hour each by rectum, urethra and bladder to various positions. In one such case it was given twenty-one times through the rectum and fourteen times through the urethra and bladder as shown in Figures 10 and 11. The only modification which has been made in the past 4 years has been to employ an instrument, the beak of which is protected by a gutta percha cap, scrupulous care being taken to avoid applying radium twice in

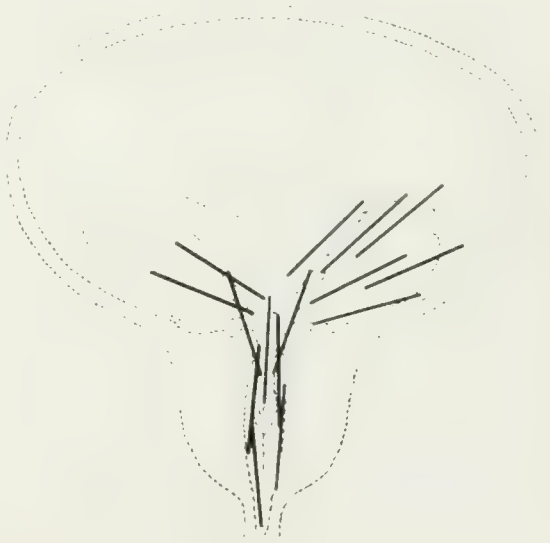

Fig. 9. Chart showing the transvesical and transurethral treatments given in each case illustrated in Figure 8 Each line represents 100 milligram hours.

Fig. 10. Mechanical hand in use in treating cancer of seminal vesicles and prostate through rectum.

Fig. 11. Mechanical hand or clamp holding radium instrument in position desired.

the same place, generally the successive treatments being given to places quite remote from each other, and alternating between the rectum, urethra, and bladder. Before the introduction of these methods it was freely stated that it was impossible to employ radium in sufficient dosage through the rectum without producing radium burns. By means of this technique, in which the radium is placed in position with the finger in the rectum and held there by the cystoscopic clamp, care being taken to avoid regions that have already been treated until 2 or 3 weeks have elapsed, radium burns and even pronounced irritation have been practically eliminated, so that we now find it possible to give with impunity twenty treatments, 1 hour each, through the rectum with 100 milligrams properly screened in the small applicator above described. The treatments through the urethra (which furnishes at least four or five separate and isolated positions), and through the trigone and lateral portions of the base of the bladder, are of very great importance as only the mucous membrane and submucous tissues separate the radium from the carcinomatous prostate or vesicles. Since the introduction of Barringer's needles, we have added this method of treatment to our routine technique, and now employ two needles at a seance, each of which, containing 12½ milligrams, is inserted through the skin of the perineum (which has been cocanized) into one or both prostatic lobes or even into the carcinomatous mass above the prostate or along the lateral wall of the pelvis in the region of the seminal vesicles (Figs. 12, 13 and 14). These needles are allowed to remain in place for a period varying from 18 to 24 hours. They are introduced under the direction of a finger in the rectum (which should not be covered with glove or finger cot in order to be acutely sensitive to the exact position of the needle). This procedure should be repeated three or four times during the first series of treatments and adds a valuable amount of radiation to the central portions of the prostate and seminal vesicles where it is most remote from the radium applied through urethra, bladder, or rectum. As at present given, one complete series consists of an hourly treatment of 100 milligrams of radium properly screened and applied with the special applicator alternately 20 times through the rectum, 10 times through the urethra, and 10 times through the trigone and also 12½ milligrams 8 times through the perineum. As noted before in these regions there is sufficient area to provide for treatments which do not overlap or repeat at the same spot and therefore do not produce ulcerations. With such a series of treatments most amazing resorption of extensive carcinomatous involvement of prostate and seminal vesicles and tissue adjacent to them is obtained in the majority of cases, and along with it there comes a disappearance of pain and obstruction, a return usually to more normal urination and freedom from straining which is indeed remarkable. Figure 10 shows

Fig. 12. Radium needles being applied. Finger in rectum, determining course and position of needle.

Fig. 13. Sagittal section to show finger in rectum and position of radium needle.

radium applied through the rectum with patient upon his side and the clamp in operation. Figure 13 shows the instrument in place for treatment of the urethra or bladder.

Recently I have constructed an applicator which carries in the beak two tubes of radium, 100 milligrams each, placed end to end and thoroughly screened with 2 centimeters of platinum and a thin layer of gutta percha. This materially shortens the treatment as 200 milligram hours is given each hour with this applicator instead of 100 milligram hours

DETAILS OF TREATMENT

Before mounting the table patient should empty bladder, and if necessary evacuate bowels. For treatments through the rectum no anæsthesia is necessary. For the urethra and bladder it is well to inject 4 per cent procaine before introduction of radium applicator. In very painful cases it may be desirable to give a sixth of a grain of morphine or opium suppository one-half hour before treatment. In some cases treatments can be given twice a day, but usually the patient objects and one treatment of 1 hour each day is all he will take. We usually alternate between urethra, rectum and bladder, picking each time an invaded region which has not been previously treated. The record of treatment is made upon either the prostatic or urethral and bladder chart, as shown in the accompanying cases. A line is drawn showing exactly where the radium was applied and the date is indicated on the line which points to the site of application. The treatments through the perineum with needles is indicated in a similar way upon a third chart, thus the entire treatment is recorded simply upon one page, and the operator can determine at once the location to be treated next in order to avoid overlapping and consequent burning. Another series of rectal charts, four in number, are made two weeks apart. These show the progress of the case and often demonstrate remarkable disappearance of extensive infiltration and induration, as shown in some of the cases charted below. The subject of results, however, will be left to Dr. Clyde L. Deming, who will present a careful study of over one hundred cases. It is necessary to explain that during the period of the war the vigorous attack which had been outlined in our first paper was not carried out, and many of the cases in which Dr. Deming is forced to report received inadequate treatment but they may be used to show the imperfect results obtained by insufficient treatment and to be contrasted with those which have been thoroughly radiated, according to the method above outlined. In a certain proportion of cases, probably 10 per cent, obstruction persists, and the presence of residual urine and frequent urination necessitated operative removal of the obstruction. In these

Fig. 14. Radium needles in position.

cases I have pursued a plan which I have employed in carcinoma of the prostate (associated with hypertrophy or with great obstruction) since 1905, viz., conservative perineal prostatectomy with enucleation of the obstructing median and lateral lobes and careful preservation of the urethra and ejaculatory ducts. Almost invariably the patient is given as thorough a treatment as possible with radium through the rectum, urethra, and bladder before the prostatectomy is carried out. During this course of radium treatment in most cases the obstruction disappears, but in others operation is necessary and the results obtained are generally functionally as good as in benign hypertrophies. In some cases radium is introduced into the prostatic cavities at operation, but care must be taken to protect the rectum by sponges and rubber protective which hold the radium sufficiently far away from the rectum.[1]

RÉSUMÉ

In conclusion it may be said that by the technique which we have above outlined really remarkable results are often obtained in apparently incurable and very extensive cases of carcinoma of the prostate and seminal vesicles. Extraordinary functional results are sometimes obtained with relief of pain, hæmaturia, difficulty and frequency of urination, and attending discomforts. In some cases apparently radical cures have been obtained, but time is yet too short to pronounce definitely upon this point. Suffice it to say that in a desperate class of cases, a great boon can often be furnished and their remaining months or years at least made far more comfortable.

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[1] In a recent case of carcinoma of the prostate and right seminal vesicle, I first made a perineal incision and exposed the posterior surface of prostate and vesicles as in perineal prostatectomy (without opening the urethra) and then introduced bare tubes of radium emanation, 1 m.c. in amount, one cm. apart. No difficulty was experienced in implanting the tubes over the entire area of induration, and also well above the vesicles. This method would seem to furnish a very accurate method for radical treatment with radium.

RESULTS IN ONE HUNDRED CASES OF CANCER OF PROSTATE AND SEMINAL VESICLES, TREATED WITH RADIUM

By CLYDE L. DEMING, M.D., Baltimore
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I. Results of Radium Treatment in 100 Cases of Cancer of Prostate and Seminal Vesicles

BY the use of surgical, internal, and autoserum therapy, science has failed thus far to produce satisfactory results in the treatment of extensive carcinoma of the prostate. As a consequence, medicine has turned its attention in another direction, namely to the use of radium. Many institutions have been using radium for a number of years, and now private physicians are tempting its healing qualities. The many details of this treatment are by no means well understood as indicated by the different forms of radium used, the amounts used, and the large number of instruments invented for its application. Yet, the world having been aroused by the great possibilities of the γ-rays, is anxiously awaiting results concerning the cure of this fatal disease. Like the surgical results for cancer, so with the results of radium we must be content to wait a reasonable length of time before a cure can be definitely determined. Prostatic cancer is one of the slowest growing malignancies, and even after an elapse of 4 or 5 years after treatment, we may not be justified in pronouncing a cure. Hence, we must expect results will be given with a great deal of caution. However, we feel that the time limit is past and we are apprehensive to receive the results which have already been obtained.

The paper by Dr. Hugh H. Young on "Technique of Radium Treatment for Cancer of the Prostate and Seminal Vesicles" shows an evolution in the technique of applying this means of treatment which has been devised by him at the James Buchanan Brady Urological Institute. The growth of this therapy, like the development of many medical problems, has profited by its mistakes. The results during such progression must be expected to show variation. This paper shows the results obtained at the Brady Institute in 100 cases of prostatic cancer treated with radium.

The statistics extend over the war period during which time the great care and precision of treatment could not be carried out. Some cases were receiving too large doses at one sitting, while others were receiving too frequent treatments in the same area, and still others were receiving inadequate doses. All cases included in this series were patients with advanced and extensive cancer who were considered beyond the operable stage.

The study of incidence of these 100 cases shows that the youngest to develop such an advanced type of cancer was 45 years and the oldest was 84 years. The largest percentage of cases is found in the seventh decade which includes 45 per cent. Thirty-five per cent occur after this decade and 80 per cent after the sixtieth year.

TABLE I.—AGE ON ADMISSION FOR TREATMENT

No. of Cases	Year	Percentage	Decade
3	45th to 50th	3	Fifth
17	51st to 60th	17	Sixth
45	61st to 70th	45	Seventh
25	71st to 80th	25	Eighth
10	81st	10	Ninth

The diagnosis of cancer was made in all cases by rectal examination. All cases presented the same physical findings as did 175 others which were operated on in this clinic, and all proved microscopically to be cancer. The prostate was enlarged, broad, irregular, nodular, fixed, and stony hard. The seminal vesicles, when invaded, were found broad, flat, indurated, forming an intravesicular plateau. In many of the cases lymph glands were palpated along the lateral walls of the pelvis. The seminal vesicles were involved in 90 per cent of the cases. The membranous urethra was invaded in 51 per cent. It was broad, hard, firm, and in some cases presented a tubular-like growth. The rectal wall was invaded in 15 per cent of cases. No ulcerations were found in the rectal mucosa. All cases then were typical of extensive cancer growth.

The amount of radium used varied greatly, ranging from 300 to 6225 milligram hours, the average being 1600 milligram hours, but this average is no criterion for ideal results as will be shown later in this paper. The radium was given in courses or series extending over a period of 4 to 6 weeks after which there was an interval of

rest for 2 to 3 months when the second series was given. The largest number received only a single series, while a few received as many as five series extending over a period of 2 years.

The treatments were administered per rectum, per urethram, and per vesicam, and a combination of these as described by Dr. H. H. Young (1). Fifteen received rectal treatments alone, three urethral alone, and one intravesical alone. Fifty received a combination of rectal and urethral, 26 a combination of rectal, urethral, and intravesical; 3 rectal and intravesical; 2 urethral and intravesical—in all 99 received rectal treatments, 83 urethral, and 31 intravesical.

RESULTS

In studying the results of radium treatment of carcinoma of the prostate, we find that they naturally fall into four groups: (1) *Symptomatic and functional*, where the frequency, dysuria, hæmaturia, dribbling, and the size and force of the stream have improved or returned to normal; (2) *local*, where there is a change in the size and consistence of the prostate and seminal vesicles; (3) *good* results or lasting results after 4 years of complete subsidence of all the symptoms, and where the prostate and seminal vesicles no longer present the characteristics of malignancy, but are soft and elastic; (4) those cases which showed *no relief* of symptoms and no actual change in the prostate and seminal vesicles.

SYMPTOMATIC AND FUNCTIONAL

Symptomatically, the results from radium have been most remarkable. Seventy-seven per cent of the cases show a relief of some or all of the symptoms. Patients who have been suffering from marked frequency, occurring every 10 to 60 minutes day and night, others who have hesitancy and pace the floor only to void very small amounts of bloody urine with a much diminished stream, and still others who have constant pain in the back and thighs, have been completely relieved. Striking are the results in those cases who have had a suprapubic cystostomy for relief of complete obstruction, when, after a series of treatments, the wound spontaneously healed and the patient gradually developed a normal act of micturition. The mental anxiety associated with these cases must not be forgotten. Many of the patients resume their normal mental status and gain weight and strength after a course of treatment.

Hæmaturia. Blood in the urine was present in 17 per cent of the cases. This was due to the extension of the tumor through the bladder or urethra. Radium applied to these surfaces caused an immediate cessation of bleeding similar to application of radium to the surfaces of bladder tumors or to the cancer of the cervix. All of the cases responded within a week or 10 days or after two to four treatments.

No. 4977 was a patient aged 68 who had hæmaturia for 6 months. The bleeding was present at each urination but varied its appearance, occurring sometimes at the beginning and sometimes at the ending of urination. Rectal examination proved the cancer to involve the posterior half of the prostate and the whole of both seminal vesicles. Cystoscopy showed the cancer breaking through the trigone. On March 24, 1916, 100 milligrams of radium were applied to the right side of the trigone and 50 milligrams to the left side. On March 27, 100 milligrams were applied to the left side. All treatments were given intravesically. The patient was next seen on April 3rd. Hæmaturia had entirely subsided. Patient lived for one year, dying of general carcinomatosis, although he received a total of 2900 milligram hours of radium. He never had a recurrence of blood in the urine and lived a comfortable life except for pain in back during the last 2 weeks of life. Such is the record of those complaining of hæmaturia. All of them responded immediately to the treatment and were permanently relieved.

Complete retention. Complete obstruction to urination was noted in 17 cases. (Several of these cases were able to pass a few drops of urine, perhaps an ounce in 24 hours.) They were being catheterized regularly by themselves or by physicians. Catheterization was painful in most of the cases as they had a marked cystitis together with urethritis. The urethra in these cases is unlike that seen in benign prostatic hypertrophy cases in which the urethræ are encroached upon by large, soft, and elastic lobes, causing potentially enlarged urethræ, while in the carcinoma cases the caliber of the urethræ is smaller than normal. It is firm and rigid due to the infiltration of the suburethral tissues by the tumor. Radium in these cases has produced remarkable results. Fifteen of them began to void after twelve or fourteen treatments. Seven were completely relieved of residual urine, while 8 showed a diminution which varied from 10 to 50 cubic centimeters. Two were unable to void after 2100 milligram hours. These two were obstructed due to benign median lobes. Where there is much hypertrophy, the result of radium on obstruction and residual is not so pronounced.

No. 5445 was admitted with complete retention. He was 80 years of age. History of urinary symptoms dated over a period of 2 years. He had residual urine of 400 cubic centimeters. The prostate was considerably larger than normal, irregular, indurated, and stony hard. The right seminal vesicle was corded, irregular, and adherent. The left seminal vesicle was an inch broad, flat, indurated, and extended upward as far as the finger could reach. There was an intervesicular plateau. The membranous urethra

was obscured by adhesions and by the low position of the prostate which was invaded by the tumor. There were no enlarged glands felt. The rectum was smooth and moved freely over it. Radium was applied, 600 milligram hours to the rectum, 600 milligram hours in the urethra, and 200 milligram hours intravesically in a period of 6 weeks. Two weeks after the beginning of treatment the patient voided small amounts of urine. At the end of the series, patient was voiding all his urine. Urinations occurred every 3 to 4 hours without hesitancy, urgency, or dysuria. The size and force of the stream was almost normal. Rectal examination at this time showed great reduction in the area of induration in both the prostate and seminal vesicles, and one would not recognize the condition as one of carcinoma. The patient's urinary condition returned to normal and remained normal for 4 years. His general condition improved and he gained 15 pounds in weight. Patient has not been examined for 2 years but replies to questionnaire that he voids every 3 to 4 hours without difficulty.

Still more remarkable are those cases which have had a suprapubic cystostomy for complete retention. Radium applied in these cases produces a restoration of urination through the urethra with a good-sized stream and complete control together with healing of the suprapubic wound.

No. 7684 had a month previous to admission a suprapubic cystostomy for complete retention. All the urine was draining through this wound. After a series of radium treatment extending over a period of 6 weeks, the wound was entirely healed and the patient voided with a good-sized stream every 3 hours. No. 8271 had had 6 weeks previously a suprapubic drainage for complete obstruction due to carcinoma of the prostate and seminal vesicles. After receiving 700 milligram hours per rectum, 300 milligram hours per urethram, and 800 milligram hours per vesicam, patient was able to void naturally. Urinations occurred every 3 hours during the day and every 4 hours at night. The wound closed and the patient gained 25 pounds during the next 3 months. No. 8719 had a perineal prostatectomy 2 years previous to admission and 6 months later the wound opened and began to discharge urine. Examination showed that he had an extensive carcinoma of the prostate, seminal vesicles, and urethra. After 6 weeks of treatment, during which time he received 2700 milligram hours of radium, 1800 per rectum, 500 per urethram, and 400 per vesicam, the fistula closed and he voided freely through the urethra.

Residual urine. Sixty-six cases had residual urine, varying from 50 cubic centimeters to 700 cubic centimeters. About the third week of radium treatment, the size and force of the stream began to increase and the residual urine gradually became less. Eighty-five per cent of the 66 cases were entirely relieved and were able to empty their bladders completely. Thirteen per cent showed a diminished residual, while 2 per cent did not show any change. No. 7521 had 400 cubic centimeters residual urine on admission. After 6 weeks of radium treatment, during which time 1400 milligram hours were given, the residual urine had entirely disappeared and patient was voiding with ease. Since 60 per cent of the cancer cases had an infected urine, the relief of this residual adds greatly to the comfort of the patient and likewise removes the great possibility of a septic process supervening a malignancy.

TABLE II.—IMPROVEMENT IN SYMPTOMS

Before Treatment		Result of Treatment		
Symptoms	Percentage Present	Percentage Entirely Relieved	Percentage Improved	Percentage Unimproved
Frequency	96	57	25	18
Nycturia	95	57	25	18
Dysuria	80	90	—	10
Hæmaturia	17	100	—	—
Hesitancy	65	80	7	13
Dribbling	76	75	5	20
Small stream	87	74	6	20
Complete retention	21	95	—	5
Residual urine	61	85	12	3
Pain in back	28	60.7	—	39.3
Pain in extremities	22	59	—	41
Loss of weight	14	57.1	—	42.9

Hesitancy. Delay in starting the urinary stream was noted in 65 cases. In 80 per cent of these it cleared up completely; 7 per cent were improved, and 13 per cent remained uninfluenced by the radium-rays.

Dribbling. Seventy-six patients gave a history of dribbling of the urine either at the beginning, during, or at the end of urination. In 75 per cent of these this symptom entirely subsided, while 5 per cent were improved and 20 per cent remained unaffected.

Size and force of stream. There was a larger percentage of cases who showed an impairment in the size and force of the urinary stream. While many of these patients had dribbling, there were some who had only a diminished size of stream and voided with little force. The statistics show that 87 per cent voided with much diminished size and force of stream. The effect of radium is practically the same as that on dribbling (75 per cent relief). The relief of this symptom is one of the earliest signs of improve-

ment. Usually after 10 to 12 treatments, there is a notable difference with regard to the ease with which the stream starts and the force with which it flows. Both improve gradually, the maximum time limit for improvement being about 6 to 8 weeks after the termination of the treatment.

Frequency and nycturia. Frequency is one of the first symptoms to appear in cancer of the prostate. It was the most common symptom to be noted in the 100 histories. Frequency and nycturia were present in 96 per cent and 95 per cent respectively. There are, of course, many degrees of frequency, but in this classification are included all cases who voided oftener than 3 hours. Some of the more severe cases voided every 5 to 10 minutes. Fifty-seven per cent of the cases were cured of this frequency. In this group are classed all those patients who, after treatment, voided not oftener than every 4 hours during the day and who were able to retain urine at night 8 hours without discomfort. Twenty-five per cent were improved so that they voided not more frequently than every 2 to 3 hours during the day and did not have to get up more than twice at night. Eighteen per cent did not show any improvement. Some patients showing reaction to radium began to void less frequently after the third week and continued to improve, while others did not show any improvement until after the series had ended. This can be explained from our study of sections of prostates which have been removed at operation at different intervals after radium treatment. During the first 2 weeks there is considerable œdema of the tissues, especially of the parenchyma, and then there is a gradual change to fibrosis and a disappearance of the cancer cells. When the fibrous change begins, there is a shrinking of the tissues with the result of diminished pressure on the urethra and internal vesical orifice. We have noticed in a few cases an increase of frequency for a few days at the beginning of treatment and occasionally complete obstruction for a few days. This period of exaggeration of symptoms corresponds to the œdematous stage of the tissues.

No. 6759 was admitted with frequency every 30 to 60 minutes day and night. The patient received 1300 milligram hours per rectum and 200 per urethram. Three months after beginning of the treatment he was able to retain urine for 6 to 10 hours and voided with a normal-sized stream.

No. 8718 had on admission a frequency of every hour day and night. In 7 weeks he had 2700 milligram hours of radium, 500 to the urethra, 400 intravesically, and 1800 to the rectum. He had slight increase for the first 3 weeks and then the intervals between urination began to lengthen, and after 2½ months he was voiding at normal intervals.

Dysuria. Pain in the form of strangury was generally relieved after a few treatments. Burning and smarting in the posterior urethra and neck of the bladder also were greatly ameliorated. Eighty per cent of the cases complained of painful urinations. Ninety per cent of these were free from pain after the first series. The 10 per cent who failed to respond all received small amounts of radium, less than 1200 milligram hours. The dysuria usually subsided when the size of the stream increased. Some of the cases were very much improved after five treatments. It is impossible to explain so early a result due to radium. It is feasible, however, to believe that passage of cystoscope or the radium applicator might cause a dilatation of the urethra and the improvement of the act of urination. But the greater part of the result came during the fourth and fifth weeks when the rectal examination showed a softening of the prostatic tissues.

No. 6759 complained of severe burning, hesitancy, dysuria, dribbling, and frequency of every hour day and night on admission, March 2, 1916. On April 6, he had very slight irritation in the neck of the bladder which lasted until May 1. During this time he had received 1800 milligram hours of radium. Patient could then hold urine 6 hours during the day and for 10 hours during the night, and voided with natural ease.

Pain in the back and extremities. Dull aching pain in the small of the back was noted in 28 per cent of the cases. This pain was present day and night, regardless of position. It never radiated to the shoulders; it either was stationary or was referred down the thighs, especially on the outer side. Sixty and seven-tenths per cent of these cases reported an entire relief of the pain. The remainder were very little, if any, improved. X-rays were taken of most of the cases. About 65 per cent of the patients who complained of pain in the back showed metastases. The fact that metastases were present did not appear to influence the effect of radium locally.

No. 8493 was admitted complaining of pain in back, right hip, and groin. Nineteen hundred milligram hours of radium were given, 1100 per rectum and 800 per urethram, in 8 weeks. X-ray showed bones of pelvis, especially both ilia, to have evidence of general metastatic carcinoma. The bones were thickened and roughened. The lumbar vertebræ showed a marked thickening of the spine. Pain never disappeared entirely but was ameliorated, and the patient was fairly comfortable and did not require morphia. He voided every three hours during the day and every four hours at night.

In most cases pains in the extremities were described as an aching sensation, weakness, like a hot iron passing over the thighs and like

TABLE III.—CASES RECEIVING ONLY 1 SERIES OF RADIUM

No.	Milligram Hour	Frequency	Duration of Series	Symptoms Improved	Local Improvement	Irritation
1	1000	2-d	3 w	+	+	−
2	550	2-d	2 w	−	−	−
3	800	3 d	2-w	+	+	+
4	1050	2-d	4-w	++	−	
5	1200	2-d	3-w	−	−	−
6	1100	2-d	3-w		−	
7	1100	3-d	4-w	+	−	
8	1300	2-d	4-w	++	−	
9	800	3 d	4-w	+	−	
10	2600	2-d	7-w	+++	+++	+
11	500	2 d	10-d	−	−	−
12	1000	3-d	4-w		−	−
13	600	2-d	3-w		−	−
14	600	2-d	10-d		−	−
15	600	2-d	2-w			−
16	850	3-d	4-w	−		−
17	250	3-d	10-d	−	−	
18	800	3 d	3-w	+	−	−
19	400	2-d	1-w	−	−	−
20	800	3-d	3-w	−	−	−
21	1300	3-d	6-w		−	−
22	1600	3-d	7-w	++	+	−
23	1400	2 d	4-w	−	−	−
24	1900	3-d	8-w	+++		+
25	450	5-d	2-w	−	−	−
26	700	7-d	4-w	+	−	−
27	420	1-d	1-d	−	−	−
28	400	2-d	2-d	−	−	−
29	200	1-d	1-d	−	−	−
30	1050	7-d	6-w	+	+	−
31	400	5-d	2-w	+	−	−
32	700	14-d	6 w	+	−	−
33	865	14 d	4-w	−	−	−
34	200	1-d	1-d	−	−	
35	1700	6-d	8-w	+++	++	
36	1300	2-d	6-w	++	−	−
37	1525	4-d	6-w	++	−	−
38	2050	3 d	7-w	+++	++	−
39	700	3-d	3-w	+	−	
40	1850	2-d	8-w	+	+	−
41	2500	2-d	8-w	++	++	+
42	309	1-d	1-d	−	−	
43	400	2-d	8-d	+	−	
44	420	7-d	4-w	+	−	−
45	330	7-d	1-w	−	−	−
46	1800	3-d	7-w	++	+	+
47	1200	2-d	4-w	+	−	+
48	2100	3-d	8-w	+++	++	+
49	1315	2-d	4-w	++	+	−
50	1625	14-d	9-w	++	+	−
51	1445	3-d	6-w	++	−	−
52	1500	3-d	6-w	−	−	+
53	2975	3-d	8-w	+++	++	−
54	2100	3 d	8-w	++	++	−
55	1000	3-d	4-w	+	−	+
56	600	2-d	2-w	−	−	
57	900	3-d	4-w	+	−	+
58	2800	3-d	7-w	+++	+++	+
59	800	3-d	3-w	+	−	−
60	400	2-d	1-w	−	−	−
61	700	2-d	2-w	+	−	−
62	900	2-d	3-w	+	−	−
63	700	3-d	3 w		−	−
64	1000	3-d	4-w	+	−	−
65	1200	4-d	7-w	+	−	−
65				39	16	11
65	1045	3-d	4-w	60%	23%	17%

TABLE III.—*Continued*

NOTE: d = day
2-d = treatments given every 2 days.
3-d and 4-d = treatments given every 3 and 4 days.

flesh being pulled from the bones. They were mostly referred to the outer side but rarely to the inner side of the thighs; always to the muscles and never to the joints. Extremity pains were present in 22 per cent of the cases. Fifty-nine per cent of these responded to treatment, while 41 per cent showed no improvement. The improvement is probably due to resorption of the infiltration which involved nerves in the lower pelvis.

Loss of weight. Fourteen patients complained of loss of weight, ranging from 10 to 50 pounds. Most of the patients were professional men and sought relief before the picture of cancer was implanted on their external features, so that the marked anæmia, emaciation, and cachexia were rarely seen. The general health of most of the patients improved after radium treatment. Appetite returned to normal and the general physical condition became distinctly elevated. Fourteen of the cases gained weight varying from 8 to 25 pounds. The feeling of betterment usually began about the second week and continued, depending on the symptomatic result. Some patients continued to lose weight and strength, especially those who were in the later stages of the disease with signs of metastases in groins or elsewhere.

LOCAL RESULTS

The local result of radium on prostatic cancer is expressed by a change in the consistence and diminution in the size of the prostate and seminal vesicles. While the local results are not so remarkable as the symptomatic, the examining finger detects a most gratifying condition. Since the evolution of treatments has undergone many changes in technique, one would expect a variation of results which is readily borne out in the tabulations.

In 55 of the 100 cases a marked change in the size and consistence was demonstrated. The hard stony-like character was changed to a much less indurated tissue with a definite elasticity. The prostate itself became normal in size and the vesicles smaller and movable. The hard plateau gradually disappeared, leaving a sensation of a chronic inflammatory condition. The hard nodules when present in these cases melted away. The palpable glands along the side of the pelvis became indistinct and non-palpable.

TABLE IV.—SIXTY-FIVE CASES RECEIVING ONLY 1 SERIES OF TREATMENTS

No. Cases	Symptoms	Size of Prostate	Average Milligram Hours	Percentage Improved	Percentage not Improved
26	no response	no change	625	0	100
39	improved	no change	999	60	40
16	improved	decreased	1415	23	77

No. 5818 showed on admission a very large, adherent, irregular, nodular, stony-hard prostate with the process extending upward and involving the seminal vesicles. There was also a definite fixation of the prostate with the formation of an intervesicular plateau. The patient received in 2 months 2400 milligram hours per rectum and 400 per urethram, making a total of 2800 milligram hours. At the end of the series the prostate was normal in size, adherent, and chronically inflamed. There was nothing to suggest malignancy. The stony character had entirely disappeared; fixation of the structures was replaced by a definite degree of mobility. Some of the cases showed a subsidence of the hard character without a diminution in the size of the mass.

A number of these cases were operated upon and found to be benign hypertrophies coexistent with carcinoma. The radium usually affected the cancer tissue, but failed to produce any marked change in the benign hypertrophy.

The cases showing local result were given 1000 to 6225 milligram hours of radium. One to five series were administered over a period of 6 weeks to 2 years. Thirty-one cases received only one series of treatment and averaged 2300 milligram hours. Eleven received 2 series averaging 2500 milligram hours; 6 received 3 series, averaging 2900 milligram hours; 5 received 4 series, averaging 3000 milligram hours; and 2 cases received 5 series, 5227 milligram hours and 6225 milligram hours respectively. Many of these treatments were given 1 to 3 days apart with an interval of several months between series. Doubtless much better results might have been obtained had the more recent technique of treatment that is now in vogue been carried out.

The changes in the tissue occur usually about the third to the fifth week. This change can be detected shortly after the onset of symptomatic improvement. Cases vary to some degree on this point, but as a rule it can be detected near the end of the first series. Cases which had seminal vesicle involvement showed similar changes, provided radium was directed over them. It was formerly thought difficult to obtain changes in the vesicles, but it is now known that the treatments were not accurately given in these regions. A great deal can be accomplished by placing the radium intravesically over the seminal vesicles as well as high up in the rectum.

Tables III and IV show result in those cases receiving a single series of treatments. It will be readily seen that those cases which showed no response to radium received the smallest amount, while those which showed a symptomatic improvement received a larger amount and those which showed local effect or a change in the size of the tumor received a still larger amount. It is apparent that more radium is required to produce a demonstrable change in the carcinoma than to affect the symptomatology. Table IV does not indicate the degree of improvement of the symptoms and change in the prostate; for none of them received enough radium to produce a complete subsidence of all the symptoms or complete resorption of the cancer tissue.

Table IX shows that the greater the number of series the greater was the percentage of local improvement. The average amount of radium was progressive as the series advanced and it was not until 3000 milligram hours were given that the cases showed a 100 per cent symptomatic and local improvement. This amount does not necessarily mean that these patients have been cured, as different patients react differently and no two show the same status of cancer involvement. All cases receiving this amount showed some degree of improvement in symptomatic and in the local condition.

FIVE CASES SHOWING GOOD RESULTS

There were a few cases which apparently responded to radium in a remarkable manner. The immediate results were excellent. They were entirely free from symptoms and rectal examination showed regression of the tumor so that the prostate was normal in size. These patients have enjoyed apparently perfect health for 4 years: two have had a recurrence of symptons and three remain perfectly well after this interval. The amount of radiation has been large in all these cases.

TABLE V.—CASES RECEIVING 2 SERIES OF RADIUM

No.	First Series		Interval	Second Series		Total		Results		
	Milligram Hours	Duration		Milligram Hours	Duration	Milligram Hours	Duration	Symptoms	Local	Irritation
1	2000	4-w	4-w	780	1-w	2780	2.5-m	+++	++	+ sl.
2	2600	5 w	12-w	2000	10-w	4600	6 -m	+++	+++	+ sl.
3	1050	4-w	2-w	675	1-w	1725	2 -m	−	−	−
4	2100	3 w	12-w	500	4-d	2600	4 -m	+++	++	+ sl.
5	750	3-w	2-w	900	2-w	1650	2 -m	+++	+	−
6	700	2-w	4-w	800	2-w	1500	2 -m	+	+	−
7	600	2-w	4-w	800	2-w	1400	2 -m	++	−	−
8	600	2-w	8-w	800	2-w	1400	3 -m	+	+	+
9	900	3-w	12-w	1200	4-w	2100	5 -m	−	−	−
10	300	3-d	12-w	500	5-d	800	3 -m	++	−	−
11	500	1-w	26-w	250	1-d	750	6.5-m	−	−	−
12	1200	3-w	12-w	700	2-w	1900	4.5-m	+	−	−
13	1600	3-w	8-w	500	10-d	2100	3 -m	+++	+	−
14	1000	3-w	12-w	500	5-d	1500	4 -m	++	+	−
15	900	3-w	12-w	500	2-w	1400	5 -m	−	−	−
16	1200	5-m	20-w	600	8-w	1800	12 -m	−	−	−
17	3070	5-m	16-w	2200	8-w	5270	10 -m	+++	+++	−
18	450	3-w	8-w	450	1-w	900	3.5-m	−	−	−
Averages	1248	4.4-w	10-w	786	2-w	2065	4.3-m	66.6	50.0	22.2

d = day. w = week. m = month. sl. = slight.

TABLE VI.—CASES RECEIVING 3 SERIES OF RADIUM

No.	First Series		Interval	Second Series		Interval	Third Series		Total		Results		
	Milligram Hours	Duration		Milligram Hours	Duration		Milligram Hours	Duration	Milligram Hours	Duration	Symptoms	Local	Irritation
1	1200	3-w	5-w	400	2-w	7-w	500	4-w	2100	5-m	+++	+++	−
2	2160	6-w	6-w	885	1-w	3-w	265	1-d	3290	5-m	+++	+	+
3	725	2-w	10-d	1115	3-w	3-w	920	3-d	2760	3-m	+++	+++	+
4	1400	4-w	10-w	300	1-w	3-m	500	1-d	2200	7-m	++	−	+
5	1300	4-w	1-w	750	3-w	7-w	675	2-w	2725	4-m	+	++	−
6	1200	6-w	5-w	400	2-w	9-w	400	3-w	2000	6-m	−	−	−
7	800	12-d	4-w	600	8-d	6-m	600	10-d	2000	8-m	−	+	+
8	1800	4-w	6-w	900	3-w	6-w	400	8-d	3100	5-m	+	++	+
9	400	3-w	2-w	700	6-w	2-w	600	4-w	1700	5-m	−	+	−
10	1450	2-w	6-w	1100	3-w	4-m	400	3-d	3150	7-m	++	−	−
	1243	3.6-w	4.7-w	735	2.5-w	9.1-w	536	1.7-w	2503	5.6-m	70%	70%	50%

No. 5230, 72 years of age, was admitted June 21, 1916 complaining of difficult urination. History dated over a period of 3 to 4 years, beginning with frequency, hesitancy, and dysuria. The frequency had increased so that he was voiding about every hour. Dysuria was the dominating symptom. Six weeks before entry to the hospital complete retention occurred. On admission rectal examination showed a markedly enlarged prostate. It was smooth and elastic, although the impression given was that of an underlying markedly indurated posterior lobe which was malignant. The outlines of the prostate could not be distinctly made out. The mass extended well up on the left to the left wall of the pelvis and was densely indurated and adherent. The right lobe of the prostate was not so markedly enlarged. The right seminal vesicle was invaded in its lower portion, densely indurated and adherent. Along the outer portion of the left lobe there was a hard nodular area. The membranous urethra was involved in a mass of marked induration. The lower portion of the prostate and that part extending up over the left lobe was practically of stony hardness. The bladder wall above the upper confines of the prostate was soft and yielding. He was treated by retention catheter and given radium to the amount of 2050 milligram hours, 200 milligram hours of which were given through the urethra, the remainder of which was applied through the rectum during the following 8 weeks. At the end of 6 weeks the patient was voiding at rather frequent intervals but without pain. He was then given 200 milligram hours per urethram which caused a temporary obstruction. Rectal examination at the end of 8 weeks showed the mucosa of the rectum to be only slightly thickened.

TABLE VII.—CASES RECEIVING 4 SERIES OF RADIUM

No.	First Series		Interval	Second Series		Interval	Third Series		Interval	Fourth Series		Total		Results		
	Milligram Hrs.	Duration		Milligram Hours	Duration		Milligram Hours	Duration		Milligram Hours	Duration	Milligram Hours	Duration	Symptoms	Local	Irritation
1	875	2-w	7-w	350	1-d	6-w	1135	10-d	3.5-yr.	700	1-w	3160	3⅓-y.	++	+++	–
2	1460	4-w	3-w	700	2-w	2-w	960	4-w	2-m	200	2-d	3320	9-m	+++	+++	+
3	980	2-w	2-w	325	5-d	5-w	500	10-d	2-m	1100	3-w	2905	5-m	+++	+++	–
4	700	2-w	13-w	600	10-d	6-m	600	10-d	14-m	1800	6-w	3700	2-yr.	+++	++	+
5	700	2-w	5-m	300	5-d	4-m	600	2-w	12-m	500	8-d	2100	22-m	+++	++	+ sl.
	943	2.5-w	9-w	455	5.6-d	2.5-m	759	2-w	15-m	860	2.2-w	3037	20-m	100%	100%	60%

TABLE VIII.—CASES RECEIVING 5 SERIES OF RADIUM

No.	First Series		Interval	Second Series		Interval	Third Series		Interval	Fourth Series		Interval	Fifth Series		Total		Results		
	Mg. Hr.	Durat'n		Mg. Hr.	Durat'n		Mg. Hr.	Durat'n		Mg. Hr.	Durat'n		Mg. Hr.	Durat'n	Mg. Hr.	Durat'n	Symptoms	Local	Irritation
1	1100	4-w	3-w	1400	5-w	6-w	900	4-w	4-w	1550	4-w	6-w	1275	3-w	6225	8.5-m	+++	+++	+
2	1100	2-w	11-m	500	1-w	4-m	700	1-w	3-m	400	4-d	4-m	1000	2-w	3200	24-m	+++	++	+
	1100	3-w	6-m	850	3-w	2.7-m	800	2.5-m	2-m	975	2.5-w	2.7-m	1135	2.5-w	4712	16-m	100%	100%	100%

The prostate was very little larger than normal. The consistence was rather elastic and would impress one, feeling it for the first time, as a moderate grade of benign prostatic hypertrophy. The right lobe was a little more indurated than normal, particularly on the periphery. Otherwise, the consistence of the prostate showed nothing which indicated malignancy. The seminal vesicles were just palpable; they were soft and elastic. During the next year the patient gained 17 pounds and general health improved. Urinations took place every 3 or 4 hours. Four years later patient reported that he had begun to use catheter occasionally, voided every 2 to 3 hours, and had lost considerable weight and strength. Patient was examined at end of 3 years but not since. At that time there was no evidence of recurrence of the cancer.

No. 4726 had complete retention on admission to the hospital and after a course of radium enjoyed 4 years of perfect health, after which he had a recurrence of urinary symptoms. He was first admitted to the hospital on November 18, 1915. His history dated over a period of 1 year. He complained of frequency and hesitancy. Two weeks before entry to hospital he developed complete retention. Rectal examination showed prostate to be moderately enlarged, the median furrow and notch shallow. Pressure in the median line elicited induration and it was impossible to pass the finger between the lateral enlargements as usual. The right lobe was irregular, nodular, very hard, almost stony. The induration was more pronounced toward the apex and toward the lateral portion. The upper end was somewhat soft and elastic, though a little irregular. The right seminal vesicle was slightly irregular, not enlarged, but moderately adherent externally, no nodules, and no marked tenderness. The induration of the prostate did not extend into the membranous urethra. The left seminal vesicle was slightly thickened, drawn outward, a little corded, and moderately indurated. One or two glands were palpable far out along the lateral wall of the pelvis. Between the two seminal vesicles the intervesicular space was soft, no indurated cords or glands. Rectum was negative. Cystoscopic examination showed slight intravesical hypertrophy of the right and left lobes of the prostate. The median portion was elevated in the shape of a bar without sulci on either side. There was no anterior cleft. The trigone was a little hypertrophied but the ureteral orifices were no closer to the prostatic orifice than normal, and the mucous membrane covering the ureteral ridges and trigone was smooth. With finger in rectum and cystoscope in the urethra, the beak was easily felt. The trigone was not thickened but the median portion of the prostate was considerably thicker than normal and quite firm. The patient was given 850 milligram hours per rectum, 785 milligram hours intravesically, and 1000 milligram hours per urethram in 3 months. During this time he had gained 20 pounds in weight. Urinations occurred every 2½ hours during the day and night without any difficulty. Rectal examination revealed a condition simulating chronic prostatitis. The left lobe was slightly irregular. The right was similar to the left. The right seminal vesicle was far less indurated than is often seen in a seminal vesiculitis. The left seminal vesicle was slightly larger than the right but of the same consistence. Six months after the beginning of the treatment, the prostate was found to be slightly broader than normal, but there was no area in the prostate or vesicles characteristic of malignancy.

The patient reported 5 years later stating he had enjoyed the best of health, had not suffered any pain or difficulty in urination except at times when there was a little hesitancy. Recently he had had to get up 3 to 4 times at night to urinate. Rectal examination showed prostate to be quite prominent, moderately enlarged, surface slightly irregular, extremely hard. Induration extended up on each side and involved the lower portion of the

TABLE IX. SUMMARY OF TABLES III, V, VI, VII, AND VIII SHOWING RELATION OF AMOUNT OF RADIUM TO DEGREE OF IMPROVEMENT

No. of Series	No. of Cases	Average Milligram Hours	Duration	Symptomatic Improvement					Local Improvement				
				Total Percentage	Percentage Degree				Total Percentage	Percentage Degree			
					+++	++	+	0		+++	++	+	0
1	65	1045	4-w	60.0	10.7	18.0	13.3	40.0	23.0	3.0	7.7	12.3	77.0
2	18	2005	4.3-m	66.6	33.3	16.6	16.6	33.3	47.6	11.1	11.1	27.4	52.4
3	10	2503	5.6-m	70.0	30.0	20.0	20.0	30.0	70.0	20.0	30.0	20.0	30.0
4	5	3037	20-m	100.0	80.0	20.0	0	0	100.0	60.0	40.0	0	0
5	2	5628	16 m	100.0	100.0	0	0	0	100.0	50.0	50.0	0	0

NOTE: +++ = complete subsidence of all symptoms or complete resorption of the tumor.
++ = moderate change.
+ = slight change.

TABLE X.—CASES RECEIVING 1 SERIES OF TREATMENTS

Result	No. Cases	Average Milligram Hours
No response	23	625
Symptomatic alone	20	990
Symptomatic and local improvement	22	1415

NOTE: Symptomatic improvement was not complete in many of these cases, nor was there complete resorption of the cancer tissue.

TABLE XI.—EFFECT OF RADIUM ON LONGEVITY

Number of Cases		Average length of life after onset of symptoms
Now dead	48	2.54 years
Not improving	13	3.60 years
Improving	12	4.40 years
Good	5	6.00 years
Unheard from	22	

(Radium treatments were begun in all cases from 1 to 2 years after onset of symptoms.)

seminal vesicles and formed a definite intervesicular plateau. There were no enlarged glands felt and the rectum was perfectly smooth.

This patient received only 2635 milligram hours of radium. Had he received over 4000 in a shorter period, say 8 weeks to 2 months he might have been cured.

No. 5193 was admitted June 14, 1916 complaining of frequency of urination and difficulty in starting the stream. Three years previously he began to urinate every 2 hours day and night. Frequency increased to every hour, associated with dribbling and difficulty in beginning urination. Rectal examination showed prostate and seminal vesicles involved in a definite carcinoma. The prostate itself was only moderately enlarged and a little more prominent than normal. Median furrow and notch were shallow. The right lobe was irregular, considerably indurated, moderately adherent, and fixed. The left lobe was much more prominent and much more indurated and larger than the right, extending well downward toward the perineum and pelvic wall. Outer edge was quite sharp and hard. The right seminal vesicle was about the size of the finger, smooth, very hard, and fixed; induration extended upward and outward in the vesicles which became gradually smaller as far as the finger could reach. The left seminal vesicle was much larger than the right, irregular, nodular, extremely fixed, very hard induration extending outward, and adherent far back, almost to the sacrosciatic notch. No glands were felt in the sacral fossa on either side. The membranous urethra was extremely hard, evidently involved down to the triangular ligament. The bulb of the urethra was not much enlarged, but definitely indurated and apparently involved. The rectum was smooth; the muscularis adherent but the mucosa soft and adherent. X-ray of pelvic bones did not show any demonstrable lesion. In three months 3200 milligram hours of radium were given, 2500 milligram hours per rectum and 700 milligram hours per urethram. At the end of this treatment rectal examination showed the rectum to be a little thickened but not ulcerated. The prostate was about normal size, fairly smooth, and a little firmer than normal. On pressure it seemed distinctly atrophic and thinner than usual. The indurated right seminal vesicle had improved immensely, was still a little firmer than normal and distinctly adherent along the outer edge, but one would not recognize it as being malignant. The left seminal vesicle was drawn outward, slightly indurated, considerably adherent, and possibly one or two small glands were felt far out, but this vesicle would not be recognized at all as malignant. The membranous urethra was a little broader than normal and somewhat indurated and fixed.

Patient's symptoms have improved and remained permanent for the past 4½ years. He voids freely every 3 hours during the day and gets up once at night. He has gained weight and is enjoying the natural mode of life. Recent report by his family physician states that there has been no change in the prostatic tissues for the past 4 years.

This splendid result was obtained with 3200 milligram hours in one series.

No. 5446, 80 years old, was admitted October 12, 1916 complaining of frequent and difficult urination. The urinary symptoms had been present for 2 years. Size and force of stream had become greatly diminished, although he had never had complete retention. At times great

TABLE XII.—EIGHTEEN CASES TREATED RECENTLY (NOT INCLUDED IN THE 100 CASES)

No.	Age	Frequency of Treatment	Radium							Results	
			Urethral	Vesical	Rectal	Interglandular (Needle)	Total	Duration	Irritation	Symptoms	Local
1	69	2–d	600	700	1300	. .	2600	6–w	slight	++	++
2	65	1–d	1000	400	1500	. . . .	2900	6–w	none	+++	++
3	67	1–d	400	400	1000	. . . .	1800	4–w	slight	++	+
4	73	1–d	500	400	1800	500	3200	6–w	none	+++	+++
5	78	1–d	800	900	2300	. . . . .	4000	6–w	slight	+++	+++
6	62	1–d	500	400	1000	. . . . .	1900	7–w	none	++	. . . . .
7	63	1–d	800	300	1300	. . . . .	2400	5–w	none	++	+
8	72	1–d	900	. . . . .	2100	500	3500	7–w	none	++	+++
9	80	1–d	500	400	1800	. . . .	2700	7–w	none	++	++
10	68	1–d	500	400	1900	. . . . .	2800	5–w	none	+++	++
11	71	1–d	1100	800	2100	500	4500	6–w	slight	+++	+++
12	65	1–d	700	500	2700	500	4400	6–w	slight	+++	+++
13	64	1–d	900	500	2300	1000	4700	6–w	slight	+++	+++
14	68	1–d	900	400	2700	500	4500	6–w	slight	+++	+++
15	71	1–d	400	500	2300	1000	4200	6–w	slight	+++	+++
16	66	1–d	1100	900	2000	1000	5000	8–w	slight	+++	+++
17	62	1–d	800	800	2400	1000	5000	7–w	slight	+++	+++
18	69	1–d	500	600	3100	500	4700	7–w	slight	+++	+++

urgency and difficulty in starting the stream were present but he had never had hæmaturia.

Rectal examination showed a prostate which was a little more prominent than normal, slightly enlarged, a little irregular, indurated, and almost of stony hardness. Prostate was moderately fixed; median furrow and notch absent. Both lobes were about equal in size. The right seminal vesicle was corded, moderately indurated and adherent, but no enlarged glands were felt on this side. The left seminal vesicle was about an inch broad, flat, considerably indurated and adherent, and the intervesicular space was partly filled with infiltration. The membranous urethra was obscured by adhesions and low position of the prostate. The rectum was smooth, movable and apparently not invaded.

Cystoscopic examination showed residual urine of 325 cubic centimeters. The bladder was quite irritable and would hold only 200 cubic centimeters. There was no cleft anteriorly and the right lobe was very slightly enlarged. The median lobe was considerably enlarged as a sessile enlargement. The left lateral lobe was not intravesically enlarged. The mucous membrane was everywhere smooth. The bladder was considerably trabeculated. The ureters were readily seen on hypertrophied ridges with pouches in front and behind them.

During the next 2 months the patient received 2000 milligram hours of radium, 500 milligram hours given per urethram and 1500 milligram hours per rectum. Patient then complained of only slight irritation in the rectum. Rectal examination showed prostate not to be enlarged. The median furrow was very narrow and shallow, being almost obliterated. The right lobe was more prominent and apparently extended beyond the mid-line; the surface was smooth and its consistency, although somewhat firmer than normal, was not of stony hardness. "It would, however, even at the present time be regarded with suspicion." The lobe was quite fixed. The left lobe was similar to the right, somewhat less indurated. In the region of the right seminal vesicle the induration described in the right lobe was felt and the vesicle was corded but appeared freely movable. A definite intervesicular plateau could be felt, the upper margin of which appeared to be quite thickened and of the consistency of gristle. The left vesicle except for a slight induration presented nothing of note. The mucous membrane was freely movable except for a slight thickening in the region of the right vesicle. The right seminal vesicle appeared normal. Patient's urinary symptoms were greatly improved. He voided every 2 to 3 hours. Residual urine was only 30 cubic centimeters.

Six months after the beginning of radium treatment he could hold his urine for 5 or 6 hours. Rectal examination showed still less induration and residual urine dropped to 10 cubic centimeters. There was no pain, hesitancy, or difficulty in the act of urination. (No treatment was given at this time. This was a grievous mistake.) Two months later rectal examination did not show any evidence of carcinoma and the picture was one of a slight grade of prostatitis and seminal vesiculitis. Fourteen months after admission the rectal examination remained the same as at 8 months, but the residual urine had increased to 75 cubic centimeters. Patient then apparently remained perfectly well for 3½ years when he began to have urinary difficulty and complete obstruction soon followed. Rectal examination at this time showed prostatic hypertrophy of slight degree. It was everywhere soft and elastic. The right seminal vesicle was not enlarged nor hard. The left was somewhat adherent but compressible. There was moderate œdema of the rectal mucosa. There was nothing to indicate recurrence of the cancer. Cystoscopic examination, however, showed a necrotic mass on the left side of the bladder which involved a portion of the vesical orifice. Whether this was an ulcer due to radium given 4 years previously or whether it was cancer was not determined. X-ray did not show any involvement of the bony pelvis.

Since the patient had obstruction to urination which was due to contracture of the neck of the bladder and to the infiltration of possible cancer growth, it was decided to give him more radium. Sixteen hundred milligram hours were given per rectum, 500 milligram hours per urethram, and 400 milligram hours intervesically. In one month patient began to void every 3 to 4 hours and residual urine ranged from 10 to 110 cubic centimeters. He had very

Fig. 1. Case 12. Chart showing involvement on admission, April 27, 1921; after treatment consisting of 1500 milligram hours, May 24, 1921; and after 4400 milligram hours, June 21, 1921.

little rectal irritation. He would leave the ward to go to an afternoon matinee and return without any urinary discomfort. Last rectal examination showed no enlargement of the prostate. The seminal vesicles were soft and elastic. There was no evidence of carcinoma. Cystoscopic examination showed ulceration of left side of bladder. Prostatic orifice showed considerable œdema. Left lateral margin was negative. Just behind it was a small necrotic mass. With finger in rectum and cystoscope in urethra, trigone did not seem to be thickened, as it is in cases which have definite carcinoma of the prostate. There was no infiltration of the suburethral tissues. Died, at home, of pneumonia 1 month later. Necropsy not permitted.

No. 5759, 75 years of age, was admitted in March, 1917. The history dates over a period of 2 years. Nycturia was the first symptom. Frequency of urination gradually increased both night and day so that he had to void every hour. Size and force of the stream had diminished so that there was considerable dribbling. He had never noticed any hæmaturia.

Rectal examination showed that the prostate was quite irregular on the surface. In the left lobe toward the periphery there was a sharp edge, rather precipitous which was characteristic of neoplasm. In the mid-line it was soft. The prostate extended up rather far in the mid-line between the seminal vesicles almost as far as the finger could reach. The seminal vesicle did not seem to be particularly indurated. The membranous urethra was soft, as was also the apex of the prostate. The growth seemed to lie between the seminal vesicles involving the posterior portion of the prostate.

Cystoscopy. The instrument was readily introduced and found 50 cubic centimeters residual urine. The bladder showed evidence of obstruction. The walls were trabeculated and there were a number of cellules. The prostatic orifice showed no clefts, some irregularity, and some œdema, but no intravesical lobes. The trigone was visible. With finger in rectum and cystoscope in urethra it was possible to make out marked thickening in the base of the prostate as the shape of the instrument could not be felt. There was present a marked indurated mass between the instrument and the finger.

The patient received three series of radium treatments during the next 6 months. The first series was given from March 16 to April 4—700 milligram hours per rectum and 200 milligram hours per urethram. On April 6 patient was voiding every 5 or 6 hours during the day and getting up once at night. He was also passing small amount of mucus per rectum. Rectal examination showed both lobes of the prostate less resistant than at first examination. Along the border of the right lobe near the base was still quite marked induration. This was true also of the left side.

On May 23 patient returned for second series of treatments. Rectal examination showed prostate considerably larger than normal, somewhat irregular, definitely softer than before the radium treatment. The left lobe was only slightly larger than normal. There was a hard area in the periphery of the right lobe and some induration at the base of the right seminal vesicle. There was no thickening of the rectum. The patient then received 600 milligram hours of radium, 500 milligram hours of which were given per rectum and 100 per urethram.

Patient received third series of radium treatments in September of that year at which time he was given 10 hours of radium of 100 milligrams each,—800 per rectum and 200 per urethram. Patient showed moderate rectal irritation, which lasted for 4 weeks only. Urinations remained normal. Rectal examination in November showed very little change in the rectal mucosa and no ulceration. The prostate was a little larger than normal, irregular, compressible, and adherent.

Two years later the patient was again examined. Symptomatically he had been free from frequency and pain. Residual urine was 15 cubic centimeters. There was a slight stricture of the urethra which was easily dilated. Rectal examination showed the prostate broader than normal and the vesicles broad and adherent; but neither the prostate nor the vesicles were very markedly adherent. The surface was fairly smooth and flat. It would have been impossible to make a diagnosis of carcinoma at this time.

Patient returned in July, 1920, stating that he had been in excellent health but during the past 6 weeks had noticed a little frequency of urination. At times he would void every 10 minutes, but could hold urine for 5 or 6 hours. He slept well and was doing his usual work. Prostate was a little broader than normal, moderately indurated, and slightly adherent. Above the prostate was a plateau which extended across the pelvic cavity, more prominent on the left side. In the mid-line there was a small area simulating an excoriated area. The patient was given 1100 milligram hours of radium per rectum over the seminal vesical regions with the result that there was resorption of the indurated areas.

Patient has not been examined for 1 year but he recently reports that his general health is excellent, he has maintained his weight, and is doing his usual work. He is voiding every 6 hours without difficulty. There is no pain in the back of thighs. He writes: "I have no symptoms that can be referred directly to the prostate and bladder."

This is a case which apparently could not endure the concentrated form of treatment. The

Fig. 2. Case 15. Chart showing involvement on admission, April 21, 1921; after 2700 milligram hours, June 6, 1921; and after 4200 milligram hours, June 15, 1921.

patient received 3100 milligram hours in four series. The result has thus far been most encouraging.

TWENTY-THREE CASES WITH NO RELIEF OF SYMPTOMS

In contrast with symptomatic, local, and good results, a certain number of cases failed to respond to radium treatment. Many of these received small doses, too small to produce any definite action on the carcinoma, while others received 1200 to 1400 milligram hours and should have shown at least a change in symptomatic condition. Such was not the case. None of these cases showed any ill effect from the radium, and there was no reason why treatment should not have been continued as far as the charts indicate, except that in a few instances patients left the hospital of their own accord. Twenty-three cases did not react to radium. A further study of these cases showed that the average amount of radium given was only 625 milligram hours, while the average for those receiving at least some improvement was 1415 milligram hours.

There was only one case which showed local results without symptomatic. This case proved to be one with well-developed growth along the urethra. He had received 1400 milligram hours of radium, all given per rectum. Had he been given extensive treatment to the urethra and internal vesical orifice, symptomatic results would almost undoubtedly have been obtained. In no case did we find that radium stimulated the growth of the cancer. It is, therefore, quite clear that those who did not show any relief of symptoms did not receive radium enough, while the next grade obtained a symptomatic improvement, and when still more radium was given, local results were obtained.

IRRITATION FROM RADIUM

The irritation from radium rays has been one factor for consideration in this therapy. It was not until after this analysis had been completed that we were able to combat the main objection to radium treatment. Twenty-eight cases showed more or less local discomfort. Some were very slight, while others were severe. However, all are included in this series so as to definitely determine the factors involved. There were no general systemic reactions such as nausea, vomiting, chills, fever, etc. All symptoms of irritation were localized and manifested by rectal and urethral burning, urgency for stool, passage of mucus, and occasionally blood per rectum, and in two cases ulceration of the rectal mucosa.

Rectal. Irritation of the rectum in the form of an aching, smarting, and burning sensation was noted in all of the 28 cases. In 9 cases it was very slight and hardly worth mentioning; it lasted for a few days and caused no change in the patient's daily routine of affairs. In other cases the irritation became intolerable. Especially was this noted on evacuation of the bowels or when fæcal matter reached the rectal area treated. The patient would then ask for an enema or opium suppository, or both. The rectal irritation began at about the tenth treatment and often lasted for 2 or 3 weeks after the series had ended. The more severe cases would complain of some pain as long as 6 months afterward.

Mucus. The passage of mucus per rectum was noted in 19 of the 28 cases. Mucus did not appear until several days after the patient complained of burning and smarting, or during the latter part of the series. Usually it was an indication to dispense with the treatment. Some cases were treated until they could not tolerate the applicator in the rectum. Those cases receiving large doses at one sitting or frequent treatments in the same area were first to show evidence of irritation. In some of the severer cases frequent bowel movements accompanied with mucus or evacuations of mucus alone were demonstrable. Never were there over eight to ten movements in 24 hours in the most severe cases, but there was

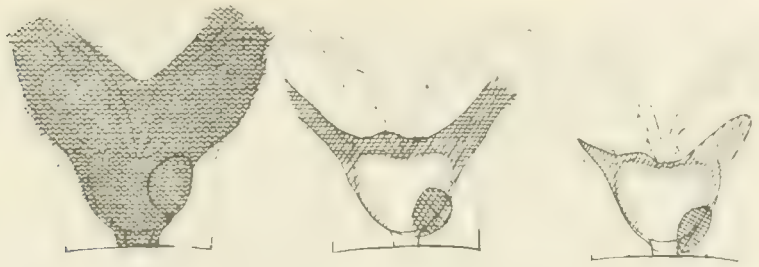

Fig. 3. Case 18. Chart showing involvement May 10, 1921; after 3200 milligram hours' treatment, June 7, 1921; and after 4700 milligram hours, June 22, 1921.

moderate tenesmus and straining at stool. In none of the cases was it permanent; in most cases it subsided after 3 weeks, but in two cases it persisted for 8 months. Urgency for stool was present in 6 of the cases discharging mucus Blood-streaked mucus was noted in 4 cases only.

Urethral. Smarting and burning sensations were the main complaints in this region, although complete retention occurred in 3 of the cases, 2 to 5 days following the first treatments. After 2 or 3 days of complete retention they began to void and in about one week the size and force of the stream gradually returned to much better quality. Five of the cases complained of urethral irritation. These symptoms were never so prominent as the rectal distress nor were they as prolonged.

Ulceration. Only two cases developed ulceration of the rectal mucosa. One healed entirely in 10 months and the other developed a recto-urethral fistula 4 months after the treatment (recently 2 other cases of rectal ulceration have appeared). The latter case showed on admission a hard nodule in the center of the prostate with little involvement of the lower portions of the seminal vesicles. He received 2800 milligram hours of radium, 200 of which were given in the rectum over or near the nodule. The result was complete resorption of the mass and the development of ulceration. The patient complained of considerable burning and tenesmus for 6 months. He, however, suffered very little from the small fistula. He makes a statement 6 years afterward that he is doing as much work as ever and feels perfectly well, except that he has in 24 hours three to four bowel movements, a good part of which is composed of urine. No fæcal material has ever passed the urethra. His urinations are not oftener than normal and he does not have to get up at night. He is apparently cured of the cancer, although he had never returned for further examination. These two cases occurred early in the use of radium. None of the last 150 cases have developed ulcerations. It is certain that they can be avoided and must be kept in mind when giving a large series of rectal treatments. Large urethral treatments will give rectal irritation as well as rectal treatments, and occasionally rectal treatments may cause a diminution in the size and force of the stream with exaggerated hesitancy, but this lasts only for a few days at most. If 150 to 200 milligram hours are given at one sitting in one place there is considerable smarting and burning in that area in 4 days which lasts for 3 weeks. Generally it may be stated that treatments exceeding 150 milligram hours in one place at one sitting or the same area treated oftener than once a week to 10 days will produce an irritation.

With the intensive treatment now used, no ulcerations have developed and the patient is able to tolerate 4000 milligram hours better than 2000 milligram hours given by the former method (2 recent cases may require us to modify this statement, H. H. Y.). Frequently a patient passes mucus and has from two to four stools a day with some discomfort or tenesmus, but these symptoms finally disappear. None have complained of constipation. Needles introduced directly into the cancer through the perineum for a 500-milligram-hour treatment have not caused any irritation or discomfort of any sort.

There have been no general systemic reactions with malaise, nausea, vomiting, or elevation of temperature. As a rule, the patients feel better and are able to tolerate a larger number of treatments if they are allowed the freedom of out-of-doors, and are treated as ambulatory patients rather than if we house them in their rooms for 4 or 5 weeks. Hygienics play an important rôle in the treatment of malignant disease as well as in other diseases and should be kept in mind in the treatment of cancer of the prostate with radium.

MORTALITY

The expectancy of life of a patient with cancer of the prostate is a variable factor. As a rule, prostatic cancer is a slowly developing malignancy. In estimating the length of life of a patient from the beginning of the symptoms it is almost impossible to be accurate, for many have an extensive invasion of cancer before any urinary symptoms appear. It seems, however, to be the only method which we have at our present command. The average length of life after beginning of symptoms for the 48 cases known to be dead is 2.54 years. Twenty-two patients were not heard from. They failed to answer the second questionnaire, and a third sent to the family physician failed to elicit further details regarding them. The statistics show 13 cases who are not improving and have now lived an average of 3.6 years since onset of symptoms. Many of these have improved symptomatically, and locally there has been a softening of the prostatic tissues, but there is a general decline in health due to metastases. There are 12 patients still under treatment who are showing improvement. The average length of life in this group is 4.4 years.

Those cases which are considered as good results have now lived an average of 6 years since onset of symptoms. There are 5 cases in this group. Table XI shows that, even where cure is impossible, treatment with radium tends to prolong life and that in a certain number of cases a cure may be expected.

We have no definite histological proof that radium is a cure for inoperable cancer of the prostate, but we may draw valuable conclusions regarding its effect and in this way guide our methods of application of the γ rays in such a way that in the future it may yield a much higher percentage of good results. There is no doubt that radium is as good a therapy as any that we have at our command; that patients may be relieved of much pain and discomfort in their last years, even if a cure cannot be instituted in a majority of the cases. Relief of symptoms is what the patient comes to us for just as he does in any other disease, and why should we not give him relief or even the benefit of medical science, if a cure cannot be obtained? Because a case is incurable is no reason why our profession should turn him over to the land of opiates. He should at least be given the benefit of radium therapy even if only symptomatic results can be obtained.

Table XII shows the result in 18 cases receiving at the first series the more concentrated form of treatment. The results obtained are too recent to pronounce cures and sufficient time has not yet elapsed to allow the radium to produce its total effects symptomatically and locally; but all cases except one show on discharge a very remarkable change in both consistency and size of the carcinoma. The detailed rectal findings together with the prostatic charts of three of the cases are given. These are not exceptional cases, but are cases in which, when there are no bone metastases, the results are more uniform than heretofore obtained.

CASE 12 (Table XII). April 27, 1921, rectal examination shows few external hæmorrhoids, with anal sphincter of good tone. Prostate is markedly enlarged and projects into the rectum. Median furrow and notch are just made out. The right lobe is markedly indurated, slightly irregular and markedly adherent externally. Left lobe is also markedly indurated and adherent externally, but is not so markedly indurated as the right lobe. Induration in both lobes, especially on the right, is of stony hardness. The process on the right side extends up into the vesicle, which can be felt markedly indurated. Few enlarged glands on the inner surface. The process on the left side extends up to a certain extent to the seminal vesicle, which is also greatly indurated.

May 7, 1921, patient has been treated here with radium by rectum and urethra, receiving 15 treatments, one hour each, with 100 milligrams of radium. He stood this treatment well. Until this morning he had very little difficulty in urinating but micturition was very difficult this morning. Patient got up 3 or 4 times last night, being able to void only small amounts. He was catheterized this morning and 750 cubic centimeters residual urine found. He is going home for 2 weeks and is instructed to be catheterized 2 or 3 times daily, if necessary.

May 24, 1921, rectal examination shows prostate enlarged moderately, the right being much larger than the left. The left lobe is only slightly larger than normal, smooth, slightly indurated, elastic, only slightly adherent. The upper end is slightly indurated, the induration extending upward and outward along the outer side of the left seminal vesicle, which is now soft. This induration is only of slight degree. The right lobe of the prostate is moderately enlarged, slightly irregular, slightly indurated, considerably adherent along the outer edge and near the apex, at which point it is much more indurated than elsewhere and very adherent. (Seems evident that not enough treatment has been given at this point.) At the upper end of the prostate, there is a line of irregular infiltration, of considerable degree, which extends upward and outward along the pelvis, as far as the finger can reach. Slightly enlarged glands are palpable here. The seminal vesicles are distinctly palpable, probably invaded. Between the vesicles there is slight induration. (See Fig. 1.) The membranous urethra is broader than normal, moderately indurated. Patient then received 2900 milligram hours.

June 21, 1921, patient returns for observation for the third time. He has had no treatment for 2 weeks. Patient stated that he has had a good deal of discharge from "bowels," at times is constipated, and at other times has marked frequency of stools if he takes a purgative. There is no pain or discomfort in the rectum, except during stool. He passes a good deal of mucus, but this condition is improving. Vesical condition is very greatly improved. He voids urine at normal intervals, without difficulty or

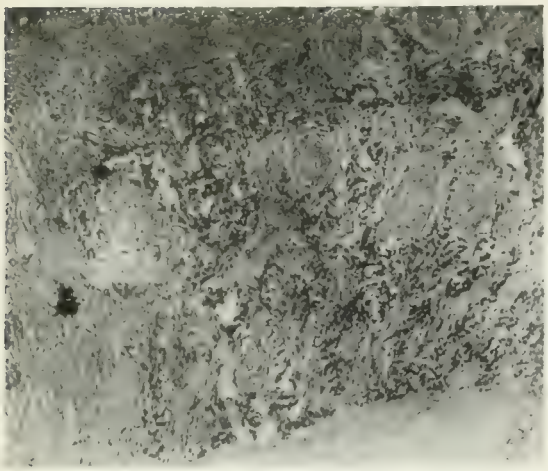

Fig. 4. Scirrhus cancer of the prostate.

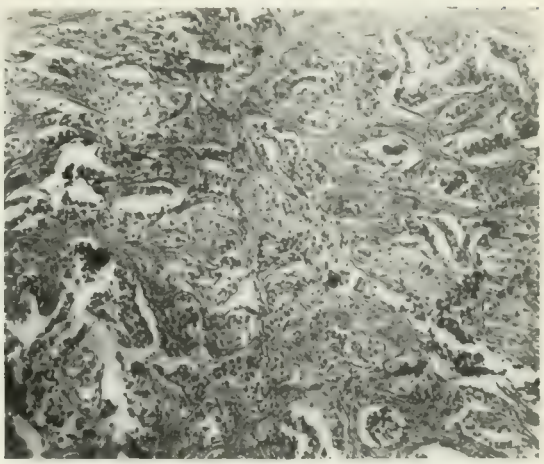

Fig. 5. Adenocarcinoma of the prostate.

pain. There is no pain in back, hip, or thighs. General condition has been fairly good. He simply returns for observation.

The anal sphincter is in good condition. Prostate is now a little broader than normal especially on the right side. Left lobe is about normal size and consistence and is not adherent. Left seminal vesicles are apparently not indurated and only slightly adherent along the outer edge. The right lobe is little broader than normal, slightly indurated and slightly adherent. There are a few adhesions running up along the wall on each side. The condition does not even now suggest carcinoma. Between the vesicles the tissues are quite soft. Examination causes slight bleeding from the rectum.

Case 15 (Table XII). April 21, 1921, rectal examination shows sphincter of good tone, with no external hæmorrhoids. The prostate is moderately enlarged, projects into the rectum, median furrow and notch obscured. The right lateral lobe is smooth, elastic, moderately indurated. The left lobe is more prominent than the right, smooth, elastic, moderately indurated and somewhat adherent. The seminal vesicles are drawn out and adherent laterally with some induration at their bases. There is no intervesicular plateau of induration. The base of the bladder feels soft. On the left side a small hard body is felt, probably a phlebolith.

Cystoscopy. Prostatic orifice shows no cleft anteriorly. There is a markedly elevated median portion. With finger in rectum and cystoscope in urethra, the trigone is not thickened. Median portion of prostate is much thicker and longer than normal and quite firm, somewhat nodular. The left lateral lobe is nodular and indurated but still somewhat compressible, the right lateral lobe the same. The whole prostate forms a transverse mass around the shaft of the instrument and the induration and enlargement beneath the urethra extends to the apex, in other words there is a suburethral thickening which extends practically to the apex of the prostate and which itself suggests malignancy. Induration, however, is not of stony hardness.

June 6, 1921. Patient has now had 18 treatments per rectum, 4 per urethram, and 5 by bladder, a total of 27 treatments. During the past month his general condition has improved remarkably, he has gained 5½ pounds in weight, appetite has improved, and patient feels very much stronger. Patient voids about every 3 hours, moderate-sized stream with natural act of micturition, force of stream not quite normal. No headache, backache, or pain in the thighs. Patient has had some rectal irritation, passes a small amount of mucus but never any blood. Patient has had some frequency of bowel movement, about 7 or 8 a day, but the rectal condition has now improved so that the bowels move only once or twice a day. Patient considers himself remarkably improved.

Rectal examination, June 15, shows a prostate that is now normal in size and consistence, not nodular, not indurated except slightly, not adherent. The change is really remarkable. Right seminal vesicle now feels only slightly indurated along the outer edge, no enlarged glands or adhesions are felt. Left seminal vesicle is also small and soft, not indurated or adherent. Rectal wall is somewhat swollen and redundant but does not feel ulcerated.

From examination at present one would never suspect that this patient had carcinoma of the prostate and seminal vesicles.

Case 18 (Table XII). May 10, 1921. Rectal examination shows anal sphincter good, somewhat spasmatic. Prostate is very irregular. Left lateral lobe is somewhat nodular, extremely indurated, fixed, induration almost of stony hardness and extending down along the membranous urethra but not palpable in the bulb, external to the triangular ligament. Right lobe of the prostate is also irregular, markedly indurated, extremely prominent as you go backward and the induration extends forward to the left lateral wall of the pelvis and obscures the seminal vesicles. This indurated mass makes it impossible to feel the left seminal vesicle. At the upper end, on both sides, there is a transverse plateau of marked irregular induration, which extends from one side of the pelvic wall to the other, upward, as far as the finger can reach and beyond. Rectum also is everywhere smooth, and on the left side it is freely movable upon the prostate and seminal vesicle. On the right side the musculature is invaded and rectum is fixed.

June 8, 1921. Patient has had about 32 treatments. He complains only when he goes to stool, desire for which

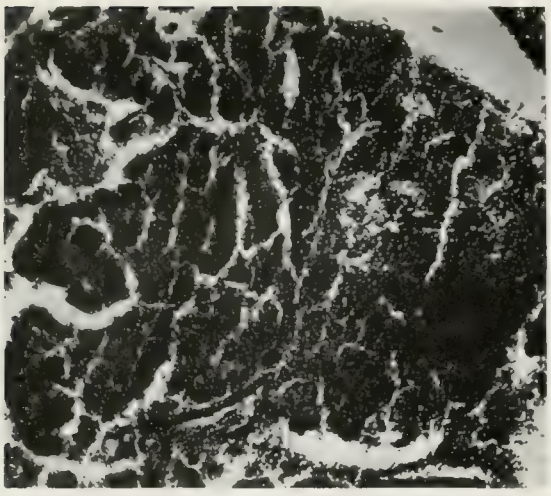

Fig. 6. Cellular or medullary cancer of the prostate.

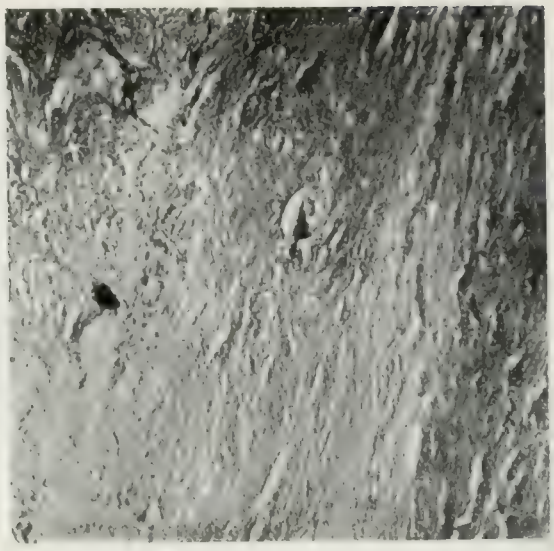

Fig. 7. Adenocarcinoma showing complete destruction of the cancer with marked fibrosis following radium treatment.

is very frequent. He is not required to get up at night for stool. He has not passed any blood but has passed a good deal of mucus. Gets up once or twice at night to void, voiding freely, good stream, without much pain. Patient has had only four treatments per urethram and none with needles through the perineum. Treatment over the seminal vesicles and along the pelvic wall are also apparently incomplete.

Rectal examination, June 22, shows anal sphincter in good condition. Rectal wall is everywhere smooth, it is not particularly tender and no areas of ulceration or excoriation are felt. Left lobe of the prostate is now about normal in size, only slightly indurated. Little nodule present at the upper end, where the induration runs upward and outward along the lateral wall of the pelvis, as far as the finger can reach. The induration in this region is only moderate in degree, likewise between the two vesicles as shown in diagram. The point in which there has been less treatment is on the right side along the outer edge and at the apex.

The cure of cancer of the prostate and seminal vesicles has thus far been a difficult problem. Surgery has failed except in a very few selected cases where the cancer is small and limited to the prostatic tissue. We attribute the failure to (1) the inaccessibility of the tumor, (2) the late appearance of the case in the clinic, (3) cases with bony metastases, (4) improper technique and (5) insufficient radiation. These difficulties are rare in surface cancer. Since the action of radium varies inversely to the square of the distance, it is, therefore, necessary to apply the γ-rays as near as possible to the tumor to obtain the maximum effect. With this basic principle in mind and avoiding the severer irritations, we should be able to control cancer of the prostate in those cases which have not developed metastases beyond the seminal vesicles.

Large doses of radium in the shortest possible time applied to all surfaces of the prostate, viz., per rectum, per urethram, and per vesicam, apparently control the peripheral growth. Cases which have shown recurrence have done so in the mid-prostatic and vesical orifice and seminal vesical areas. More careful technique has controlled all the areas except the mid-prostatic portion.

Intraglandular radiation with needles adds much to supplement the surface treatments. Either treatment without the other is inadequate. If needles alone be used then the tips of the seminal vesicles escape radiation. Cases should be examined every 3 months to detect any area of recurrence so that further radiation may not be delayed. If rigid technique with massive doses be used, we believe that cure of cancer of the prostate, provided there are no metastases beyond the seminal vesicles, lies within the scope of radium treatment.

CONCLUSIONS

1. Radium gave symptomatic relief and return of normal urination in 75 per cent of the cases.
2. Radium relieved the pain in the back in 50 per cent of cases suffering from metastases.
3. Irritation from radium can be avoided by treating widely remote areas in successive treatments and by alternating between rectal, urethral, and vesical applications.

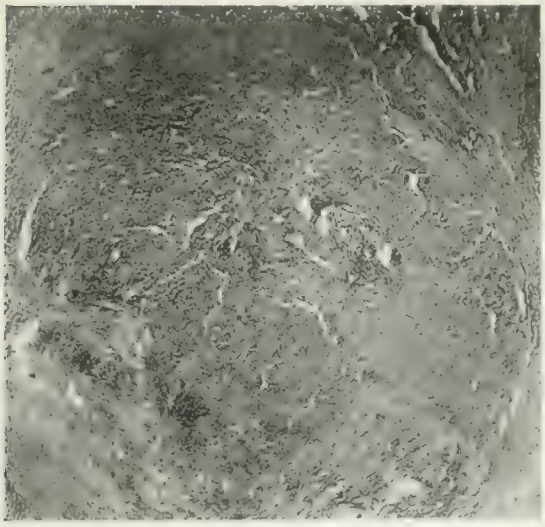

Fig. 8. Adenocarcinoma showing necrosis due to radium applied intraglandularly.

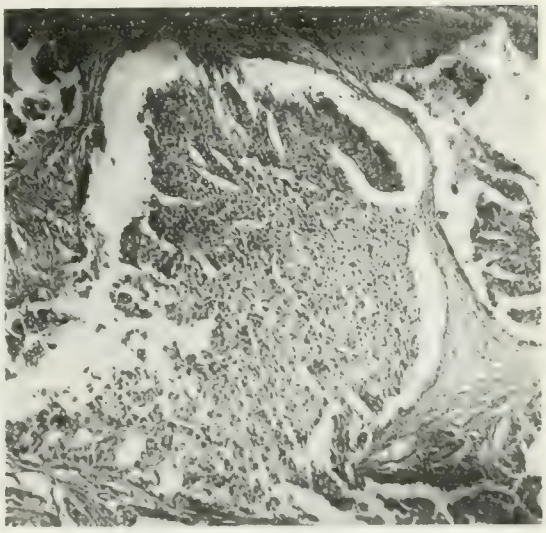

Fig. 9. Adenocarcinoma showing variable effect of radium. One-half of the alveolus shows degenerative changes while the other half shows healthy cancer tissue. —3 weeks after termination of radium series.

4. At least 1000 milligram hours must be given to produce any symptomatic improvement.

5. Fourteen hundred milligram hours must be given to produce any perceptible change in the tumor mass.

6. Three thousand milligram hours must be given to produce symptomatic and local results in the same patient.

7. Four thousand and 5000 milligram hours in a period of 6 to 8 weeks should be given if possible, in addition to needle treatments of 500 to 2000 milligram hours through the perineum.

8. Cases which did not respond to radium did not receive sufficient radiation.

9. Large doses must be given in as short a period as possible to produce maximum results.

10. No general systemic reactions have been encountered.

11. Combined extraglandular and intraglandular radiations apparently give the most satisfactory results.

12. Thus far we have no actual proof that radium has produced an actual cure for cancer of the prostate and seminal vesicles, although three cases remained free from symptoms and tumor growth for more than 4 years and many others show on rectal examination a condition of the prostate which does not now resemble cancer.

II. Results of Radium and Operation in Cancer of the Prostate (33 cases)

Radium and surgical methods have been used to give relief in some of the more difficult cases of cancer of the prostate and seminal vesicles. Herein lies a possibility which must not be overlooked as better results may be obtained in a certain number of cases by a combination of radium and surgery. Questions naturally arise: Can we remove the cancerous tissue after it has been treated with radium and increase the opportunities for cure? Can we remove most of the malignancy and treat the remainder with radium? Do we spread the cancer by operative measures? Can we obtain better results by preoperative and postoperative application of the radium, or can we at the time of operation remove as much of the cancer as possible and then apply massive dose treatments?

The operative series is a small one consisting of 33 cases. Practically all the possibilities previously mentioned have been carried out. It is certain that operative measures do not add to the risk of metastatic development. A series of 100 cases which were operated on without radium treatment lived almost as long as cases which were not operated on and which received radium treatment alone but there was no attempt to cure these cases.

This series of cases is similar to the series of 100 cases previously treated with radium alone. Ages range from 58 to 80, the largest number of cases being found in the seventh decade. There were three cases under the sixtieth year, twelve between 60 and 70 and six between 70 and 80.

The prostate was generally invaded in all the cases. Both seminal vesicles were involved in all except three and these showed an extensive infiltration in one vesicle. The average number of milligram hours given before operation was 1380, ranging from 400 to 4000. Treatments extended over a period of 1 week to 14 months. The symptomatic and functional improvements were not marked, being only 26 per cent. None of the patients were entirely relieved from all their symptoms. Thirty-eight and eight-tenths per cent showed local improvement, but not complete resorption of the cancer.

The operations performed were of two types: (1) conservative perineal prostatectomy—by means of which the cancerous tissue about the prostatic urethra and vesical orifice was removed: (2) subtotal prostatectomy—by means of which the capsule of the prostate was removed together with the cancer. There were two operative series: one which received pre-operative radium treatment and another which received post-operative radium treatment.

There were 28 cases which received radium before operation. These were treated per urethram and per rectum: 7 cases received rectal treatments alone and 20 received rectal and urethral treatments. The total radiation varied from 400 to 4000 milligram hours, the average radiation being 1600 milligram hours. Most of the cases were operated on at the end of the series of radium treatment by the conservative method. Nine cases received massive doses of radium at the time of operation. A 100 milligram capsule was inserted at the time of operation into the wound and allowed to remain from 5 to 8 hours. No untoward results have occurred and there has been no interference with the closure of the wound, in fact they have healed as rapidly as the benign hypertrophy cases. No fistulæ have developed.

Postoperative radium treatment. Five cases were operated on first and then given radium. Two received 1600 milligram hours at time of operation; the other three were given 100 milligram hours' treatment after the wound had healed. These cases, like the others, left the hospital voiding normally.

RESULTS

The time elapsed since treatment has not exceeded 4 years, so it is quite possible that some may develop a recurrence. Four cases have now lived 3 years and are apparently entirely relieved of symptoms and local tumor. Statistics show that 12.1 per cent of the cases have an excellent result—classified as "good result"; 66.6 per cent were improved; and 21.2 per cent remained unimproved. The cases showing good results have a complete subsidence of all urinary symptoms and no further development of local tumor. Those cases improved show relief of symptoms but rectal examination discloses active cancer present. The 21.2 per cent unimproved did not get relief by operative measures. There was still urinary difficulty with palpable cancer in prostatic tissue. Of the 33 cases 51.5 per cent have died. Death was due to metastases in all cases. These cases lived from 5 to 22 months—an average of 11 months after operation. Those cases in which good results were obtained received a combination of radium before and after operation. The amount of radium before operation did not exceed 2000 milligram hours in 2 of the cases. Two received 2500 and 3100 milligram hours. The operations were the conservative type. The amount of radium given after operation ranged from 1200 to 2100 milligram hours, giving a total radiation of 3000 to 4000 milligram hours. These cases have not been examined for 1 year, but they report that their urinations are normal. Last rectal examination, 2 years after operation, did not show any return of cancer.

There are two cases recently treated with large pre-operative doses of radium. Each received 4000 milligram hours. Two weeks later a perineal prostatectomy was done. Both specimens removed at operation showed hypertrophied tissue invaded by cancer. The capsule stripped readily and was free from cancer. Apparently complete resorption of the cancer had taken place in the capsule. It is fair to believe that control of the growth has been accomplished in these cases and that by removing the adenoma a cure has been obtained. Those cases receiving only postoperative radium apparently did not receive sufficient radiation as they occur in the improved group.

HISTOLOGICAL PICTURE

Study of the specimens removed at operation is the only method of deducing accurate conclusions regarding the effect of radium. The histological picture is by no means uniform. The sections from some of the specimens removed after application of 800 milligram hours of radium show considerable change in the periphery, while others taken from specimens which had received 2000 milligram hours failed to show any effect of radium whatsoever. None of the specimens showed complete destruction of all the cancer tissue, although there were areas in which destruction was complete. Just why there was such

irregularity in the histological findings we do not know, but there are several possibilities which must be considered, viz., kind of cancer, the frequency and method of treatment, and the specific or selective action of radium for certain cells.

The action of radium has been found to be of two kinds: (1) a gradual disappearance of the cancer tissue and the development of fibrous tissue and (2) necrosis.

The gradual changes produced by radium have been well described by Drs. Young and Frontz (2) and Dr. Alter (3). The effect of radium does not correspond in all cases to the amount of radium given. Some tissues show marked changes while others show little change that can be ascribed to radium. The periphery of the specimens naturally shows the first evidence of radiation. Different conditions of degeneration can be easily seen in many of the specimens, such as pyknosis of the nuclei, vacuolization, shrinking of the cytoplasm, and in some cells a few poorly stained granules. Other cells show granules taking very deep stain. Increase in fibrous tissue is a prominent factor in most of the sections. It is firm, the strands are packed tightly together and form a dense, hard tissue. Between some of the layers of fibrous tissue small darkly stained granules or outlines of a few cancer cells may be seen, indicating complete destruction of the cancer with development of fibrous tissue.

In all the cases treated with extraglandular methods no necrosis of tissue was found. Whenever a change occurred it was a picture of gradual melting away of the cancer tissue and a development of fibrous tissue. One specimen had been treated intraglandularly with two needles. Each needle contained 12.5 milligrams of radium and was allowed to remain in position for 24 hours. The operation occurred 2 weeks later. Sections from this specimen showed necrosis of all the tissue within a radius of 4 millimeters. The connective tissue stroma as well as the cancer forms a necrotic area (see figure 5). No such areas have been seen in the other specimens although some received 4000 milligram hours.

We have considered the fact that different kinds of cancer might react differently to radium and cause a diversified histological picture. There are three kinds of cancer of the prostate thus far recognized: (1) the scirrhus with small cell nests and large amount of fibrous tissue, (2) the adenocarcinoma, and (3) the cellular or medullary.

The scirrhus is not an uncommon type and is composed of dense fibrous tissue in which are small irregular nests of cancer cells, each nest containing from 5 to 10 cells. The cytoplasm stains heavily. Mitoses are rare. One gains the impression of very slow-growing, infiltrating type of cancer. Of the five cases showing scirrhus cancer only one shows changes accredited to radium and this change is found only in the periphery. The other four cases do not show any evidence of the effect of radium although two received over 2000 milligram hours of radium.

The adenocarcinomata comprise the largest proportion of specimens. The effect of radium on this type is variable. It is apparently resistant to relatively strong doses of radium, as some of the specimens had large amounts of radiation with little effect while others showed an effect which corresponded to the amount of radium given. No. 4718 is a case which received 2000 milligram hours in the same area in 9 months. Section through that area shows typical active cancer with moderate connective-tissue stroma. No. 9038 shows after 4000 milligram hours of radium given in 6 weeks a benign adenoma invaded with cancer. The prostate was removed *in toto* and sections were cut at different levels. Large areas containing solid masses of degenerated cancer cells were seen throughout the section. Here and there were a few masses of cancer cells which appeared perfectly normal in shape and outline. There was no swelling, vacuolization, or granular condition of the cytoplasm. Mitoses were rare. Why these areas remain unaffected when adjacent cancer tissue on all sides shows degenerative changes is an unsettled question. The connective tissue was rather marked in amount, but the benign adenoma was not affected. Twenty-seven of the 33 cases were of the adenocarcinoma type; 7 showed generalized carcinomatous degeneration in various stages. The amount of radium varied from 900 milligram hours to 4000 milligram hours. Of the 20 remaining cases only 8 showed changes in the periphery; while 12 did not show any evidence of degenerative effect from the γ-rays, although these received from 900 to 3000 milligram hours.

The third type or cellular cancer of the prostate is in gross a very soft mucoid, chocolate-colored material. Microscopically it is found to be made up almost wholly of cancer cells interspersed here and there with collections of red blood cells. There is a very small amount of connective-tissue stroma. One case was found among the 33 cases. Fourteen hundred milligram hours of radium were given—but no change due to radium could be discerned from the study of the sections.

CONCLUSIONS

1. A combination of radium and surgery offers a possibility for treatment of cancer of the prostate and seminal vesicles.

2. Operation does not diminish the amount of radium necessary to produce good results.

3. Operation does not increase the possibility of hastening metastases.

4. Histological picture is variable.

5. Radium does not act alike on all cancer tissue.

6. Radium has two distinct actions: one of gradual cell destruction and fibrous displacement and another of necrosis.

7. There are three kinds of cancer of the prostate: (1) scirrhus, (2) adenocarcinoma, (3) cellular or medullary.

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SHORT CIRCUIT OF THE VAS DEFERENS

By KARL P. MORAN, M.D., F.A.C.S., Portland, Oregon

IN the year 1902 Martin (1) of Philadelphia, in collaboration with several others gave out the results of a series of experiments which they had performed upon dogs, with a view to perfecting the technique of an operation designed for the relief of sterility resulting from obliterating bilateral epididymitis following gonorrhœa. These investigators felt that the success of their experiments justified them in performing the operation upon a human subject in cases in which a childless marriage was the result of azoospermia, consequent upon a double obliterating epididymitis.

Acting upon this belief, Martin performed the operation upon an apparently healthy young man, anxious for children, whose wife had been previously subjected to dilatation and curettement before it had occurred to any of those interested that the fault might possibly lie with the husband. Under ether, the vas at the left side was freed about the level of the top (of the) testis, its lumen opened, and the epididymis exposed for its entire length. The vas was then implanted in an incision in the epididymis by means of four fine silver wire sutures; a suture was placed at either end of the vas incision, and the vas itself held open by a suture on either side. Motile spermatozoa were demonstrated in the semen 19 days after the operation.

Martin remarks that the approach to the epididymis is not difficult, nor does it seriously endanger the nutrition of the testes by interfering with their blood supply. The vas lies behind the spermatic artery, which sends its main branches forward to the inner side of the epididymis, anastomosing freely at this point with the artery of the vas. The portion of the vas which is used for the anastomosis must be carefully dissected free from its surrounding vessels and nerves, and carried to the outer side of the vascular plexus of the cord until it can be readily applied to the exposed surfaces of the epididymis. Because of the smallness of the structures involved the operation is tedious rather than difficult.

About the time of Martin's operation, Scaduto (2) carried on extensive experiments upon dogs, but did not prove his conclusions by operating upon a human subject. Posner (3) in Germany also was successful with animals, but his six operations upon man were all failures. The meagerness of the literature for a number of years afterward gives evidence that very little attention was being paid to the possibilities of this particular line of work, and Quinby (4) writing 6 years after Martin, found no other recorded instance of its successful performance upon man. Quinby himself experimented with guinea pigs, and concluded that from his results, added to those obtained by Martin and the others, there was no doubt that vaso-epididymal suture with proper technique is a perfectly definite surgical possibility. Applied to the human being after the diagnosis of permanent azoospermia due to obliterating epididymitis has been established, there are three considerations which favor the employment of such surgical intervention. First, the condition after operation cannot be worse than it was before; second, since the restoration of patency on one side alone is sufficient to permit ability to impregnate, this offers the patient a double chance of cure; third, the operation, offering as it does the only rational means of relief from such a condition of sterility, has been proved feasible in both animals and man.

In the performance of the operation it is necessary to consider carefully the seat of the stenosis in relation to the anatomy of the parts, and in each instance make the union at a place which will as surely as possible create an efficient short circuit. The determination of such a spot on the epididymis can best be made by the hypodermatic syringe. Withdrawal of a drop or two of fluid and demonstration of motile spermatozoa by microscope will show clearly where to make the anastomosis.

In 1907 Hagner and Fuller of Washington (5) reported on two cases of sterility following double gonorrhœal epididymitis where operation was performed, one being done by Hagner and the other by Martin of Philadelphia, the Martin technique being employed in each case. Live spermatozoa were afterward demonstrated in the semen of both patients, but at the time the report was made no pregnancies had yet occurred, though the author remarks "I continue to hope." He adds: "Very few of these operations have been reported."

When William T. Belfield (6) made his address as chairman of the Genito-Urinary Section of the American Medical Association in 1912, he stated emphatically that the investigation of the causes of childlessness should not begin with the curet-

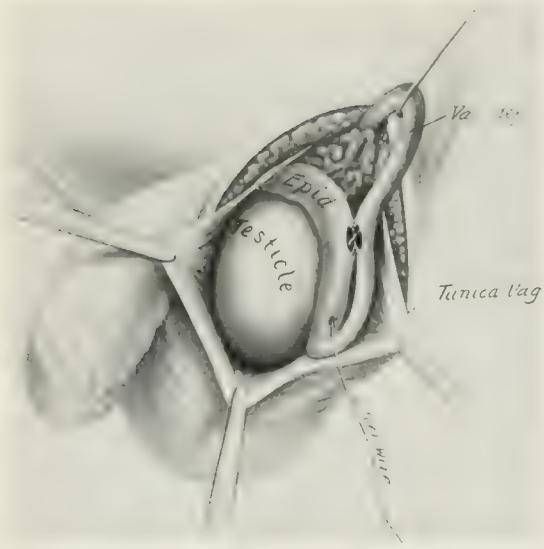

Fig. 1. method of anastomosing vas with epididymis Silver wine place.

tage of the wife, but with microscopic examination of the husband's semen. He went on to speak of the various causes of male sterility, and its treatment, but made no mention of Martin's operation, nor the possible relief of that particular form of sterility by surgical means.

However, by 1915 there was a more general recognition of the practicality and usefulness of "short-circuiting" the vas deferens. McKenna (7) published an account of the work he had done upon dogs, and reported six cases where the operation had been carried out on men. He carefully outlined his technique, which differed considerably from that used by Martin, and emphasized especially the necessity of being sure that the vas was free from all infection and that the section of the epididymis used contained plenty of free sperm; also that the tail of the epididymis should be used for the implantation. Shortly afterward Bernhart (8) in a short article on the technique of the operation stated that, contrary to common supposition, lack of success was not due to the vas failing to remain patulous but rather to the fact that the wound in the head of the epididymis has a tendency to close rapidly. The mere insertion of a strand of silkworm-gut or silver wire into the lumen of the vas deferens was not efficient—in his opinion—to keep the wound in the gland sufficiently open. He then described a loop of wire which he had devised in the hope of overcoming this difficulty. He stated that his technique had proved successful in eight

Fig. 2. Appearance of operative field after suture is completed.

consecutive cases, and that four pregnancies had rewarded his operative efforts.

Yet almost two years after this Wolbarst (9) ignores the work of both McKenna and Bernhart and says: "In gonorrhœal obstruction there is but one measure that offers some degree of hope—the Martin operation—vasoepididymostomy. At best this operation offers no guarantee of success in removing the sterility, but it should be done whenever possible so as to give the patient his only chance." He says: "In a personal experience of 18 patients I have met with gratifying success in one case. Spermatozoa were found in fairly large numbers and moderate efficiency within 4 months and pregnancy followed within a year thereafter." But McKenna continued to offer a much more cheerful outlook for anxious would-be parents. In 1918 (10) he made further reports on successful operations and also gave details of a new technique differing somewhat from that he had used 3 years before. Shortly after this the patient whose case I wish to report presented himself at my office.

H. W. L. first consulted me in April, 1919, concerning his wife. He stated that she was in need of an operation and that he wished to bring her in for examination. In reply to questions he said that his wife's health was good, but after being married for 13 years they were still without children, and he hoped an operation might be performed upon her so that she would be able to become pregnant.

Mrs. L. came in for examination 1 month later. Her history and physical examination were entirely negative. The uterus was of normal size and in good position, the ovaries were palpable and apparently normal and there was no evidence of there having been any trouble in the pelvis. When it was suggested to the husband that he might be the one at fault he declared that he was a "healthy buck" and there was no trouble with him, but questioning

elicited the information that he had had gonorrhœa some 20 years before, for which he had not undergone treatment of any kind and that there had also been a "swollen testicle" on the left side. Several specimens of semen subsequently examined showed a complete azoospermia. Though his general physical condition was negative, on both sides the epididymis was intensely engorged and the vas felt smaller than the normal size. A diagnosis was made of obstruction probably in the globis minor due to the gonorrhœal infection of 20 years before. The operation outlined by Dr. McKenna was explained to the patient and he consented to have it performed.

On May 11, 1919, under local anæsthesia an incision was made over the cord about 2 inches above the testicle, the cord exposed and the vas separated by palpating the cord between the thumb and finger. With a fine knife an incision was made into the vas. A silver wire was then introduced into the lumen of the vas, which was permitted to remain in place with about 4 inches extending into the vas. Next the epididymis was opened about its middle third, and a search made for free spermatoza. The thick creamy fluid resembling pus which immediately gushed out was placed under the microscope and showed many lively spermatozoa. The anastomosis was made by using 00 chromicized catgut. The silver wire was brought through the epididymis and out through the skin wound. Closure was made in the ordinary way, the wire coming out of one end of the wound. The wire was allowed to remain in for a period of 7 days and was then removed. This operation was done on both sides the same day.

As soon as the patient was able to leave the hospital he went to Chicago where he remained for 6 months. On his return to Portland he came in for examination and two different specimens of semen showed many live spermatozoa. His wife who is now 37 years of age is at this time 7 months pregnant.

The technique employed was that of McKenna's later method. He directs that the incision should be made just long enough to expose both vas and epididymis, recalling that the obstruction to the spermatozoa usually occurs in the globis minor. He employs the silver wire because without its use the lumen would fill and become occluded with blood-clot, which would become organized and render the operation of no value.

The results which have been obtained from this operation certainly would seem to justify its employment much oftener than has heretofore been the case.

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TETANUS COMPLICATING DIABETIC GANGRENE

By WALTMAN WALTERS, M.D., Rochester, Minnesota
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IN view of the fact that the standard textbooks of medicine, surgery, or even of diabetes do not mention tetanus as a complication of diabetic gangrene, I am reporting a case of this type which has been under observation in the Mayo Clinic. A study of this case seems to demonstrate that tetanus may develop as a terminal infection in patients with diabetic gangrene and that prophylactic treatment is indicated in certain cases.

REPORT OF A CASE

Case 341737. A man, aged 65, was referred to the Mayo Clinic November 23, 1920. He had always been well until the fall of 1917 when he began drinking more than ordinary amounts of water. At Easter time, 1920, his appetite increased noticeably; the total urinary output was doubled. Three weeks before he came to the Clinic pain appeared in the great right toe which soon began to take on a purplish color, later turning black, and losing sensation. The day preceding his admission there had been a spontaneous discharge of foul-smelling, yellowish-white material from the plantar surface of the toe. During the previous 2 years he had lost 55 pounds in weight, and had lost strength progressively. Besides these symptoms he had numbness and tingling of all his fingers extending up to the metacarpal phalangeal joints, which is characteristic of the nervous system involvement in late cases of diabetes mellitus.

An unusual detail obtained from the history was that the patient's urine had never been examined for sugar. On examination he was noticeably pale and emaciated. The great toe of the right foot was black up to the metatarsal phalangeal articulation. A purplish area of discoloration extended upward on the dorsal surface of the foot feathering out around the proximal end of the metatarsals. The pupils were miotic and did not react to light. Examination of the eye grounds showed nothing abnormal other than some fullness of the veins. The teeth were carious, the tonsils enlarged and ragged, and a few white plugs were expressed from their crypts. Palpable glands were noted in the supraclavicular fossæ. The thyroid was slightly enlarged, but no adenomata were palpated, nor were there signs of exophthalmic goiter. The peripheral arteries were markedly sclerosed, and rolled under the finger like a non-elastic tube. Over the discolored area of the right foot sensation was absent, and pulsation was not felt in the right posterior tibial artery. A 12-hour specimen of urine revealed 6 per cent sugar in 900 cubic centimeter, a specific gravity of 1,020, a large albumin content, and occasional hyaline and granular casts. The blood sugar was 0.15 per cent, estimated according to Folins' method, and the alkaline reserve of the blood plasma was 56 volume per cent, with the Van Slyke apparatus.

A diagnosis of diabetes mellitus with gangrene was made November 23; the patient was placed in the hospital and given a diet containing 150 grams carbohydrate, 60 grams protein, and 60 grams fat. November 27, he suddenly complained of stiffness in his neck and could not open his mouth more than half way. The following morning flexion of his neck was painful and the abdominal muscles were contracted. During the next 20 hours spasm of the masseters with grinding of the teeth occurred every 10 or 15 minutes. Death occurred about 30 hours after the onset of symptoms.

When the symptoms of tetanus were first noticed, a smear from the gangrenous area of the right foot showed tetanus bacilli, thus establishing the diagnosis. The patient's toe was not amputated because of his general condition. He was treated with antitetanic serum intravenously, intraspinally, and intramuscularly without appreciable effect.

The original source of the infection is uncertain, but the patient's daughter volunteered the information that the infected toe had never been covered by a dressing and had been in direct contact with a black sock. Treatment in such cases after the tetanus is well established will not be of much benefit, consequently prophylactic antitetanic serum is indicated.

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EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D. .....Managing Editor
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JANUARY, 1922

EDITORIAL FOREWORD

THE journal of SURGERY, GYNECOLOGY, AND OBSTETRICS is the official organ of the American College of Surgeons. The editors are fellows of the College and the majority of the editorial staff are members of the Board of Regents of the College who serve in this capacity ex officio. Through the generosity of the founder of SURGERY, GYNECOLOGY AND OBSTETRICS, Dr. Franklin H. Martin, arrangements have been made whereby the journal will eventually become the property of the American College of Surgeons.

During the years of its existence the Journal has ever maintained a high standard of scientific excellence. To speak further of the great work that has been accomplished by the journal in the advancement of surgery would be super-arrogation. The publication of extensive collective reviews in which a surgical subject of importance has been brought fully up-to-date has proved to be of great value, especially to those interested in the subject reviewed. The editorial board has decided to establish a department of editorials in which some surgical subject will be more briefly placed before the surgical profession by a recognized authority. It is hoped that these short editorials will be of value not only to those specially interested in the subject discussed but by their brevity will also appeal to the surgical profession as a whole.

WILLIAM J. MAYO,
Chairman, Editorial Staff
for the American College of Surgeons.

HIRSCHSPRUNG'S DISEASE

IN an interesting paper, read before the American Surgical Association at its last meeting and published in a recent number of the *Annals of Surgery*, Dowd has brought the question of the surgical treatment of megacolon pretty well up-to-date. He has also compiled a list of the literature upon the subject published since 1908, supplementing the list collected by Finney at that time.

During the last 13 years, while much has been written on the subject, little of value has been added to our knowledge of the etiology of the disease, and it must be admitted even now that little definite is known as to the true causation of the affection. Evidence is accumulating all the time to support the contention that in many cases at least no single cause is responsible for the various manifestations that have been noted from time to time by different observers. In all probability more than one factor is involved. The fact that so many theories as to its etiology have been advanced is the best evidence as to the uncertainty of our knowledge of the subject. These various theories may be roughly stated as—

1. Some congenital developmental defect in the colon. Hirschsprung, whose name has been given to this disease, was a strong

advocate of this theory. He believed that both the dilatation and hypertrophy which have been noted as present are congenital in origin. Many later writers, notably Mya, Billard, Hobbs and De Richmond, Joukovsky, and others support this contention by reports of autopsies of fœtus and young children born with various forms of dilatations and hypertrophies, chiefly of the lower bowel. Analogies of these localized ectasias are to be found in other parts of the intestinal tract—the œsophagus, rectum, etc. While it is quite likely that the two conditions of dilatation and hypertrophy are not inseparably bound together, as a matter of fact, however, they are both noted as present in almost every case reported. It is conceivable that either of these processes may be primary and the other secondary. Dilatation, however, appears to be of relatively greater etiological importance than hypertrophy, which is more apt to be secondary and functional.

Concetti advances the idea of a congenital aplasia of the muscular tunics of the large intestine immediately above the rectum. Growing out of this, as a result of the processes of fermentation and putrefaction and the formation of gases resulting therefrom, there develops a well-marked ectasia of the intestine which, in turn, sooner or later, becomes distended with large quantities of accumulated fæces.

Hawkins proposed the name of "neuropathic dilatation and hypertrophy of the colon," basing it on his conception of the etiology of the disease as a neuromuscular defect in one segment through which the colon was unable to propel its contents. This theory was also held by Formad, Lennander, Bing, and others. Richardson and Fitz called attention to the close relationship existing between this condition and phantom tumor, as showing a possible nervous origin.

2. Some form of mechanical obstruction producing conditions due directly to efforts to overcome the obstruction. These obstructions may assume various forms. Barth, for instance, thought them due to a secondary torsion of the sigmoid, the result of an abnormally long mesentery. Others, on the other hand, think an abnormally short mesentery is the cause. The increased length of the colon and a multiplication and exaggeration of its loops, especially of the sigmoid flexure, was believed by Marfan and Neter to be the cause of the trouble, the subsequent dilatation and hypertrophy being dependent on the accumulation of gas and faces in the elongated loops of the colon.

Curshmann, in Nothnagel's *System*, states that the sigmoid in early life is relatively larger than the rest of the large intestine and that we may often find a persistence of the infantile condition which may at times become "monstrous." Hirschsprung rather inclined in his later writings to this idea. Treves was a strong advocate of the mechanical obstruction theory. He insisted that the phenomena observed in this connection suggest in a most emphatic way that there is an obstruction to be overcome and that the hypertrophy is quite inconsistent with the conception of an "idiopathic" dilatation of the bowel.

Perthes, in an elaborate report, contends that valve-formation in the intestine was responsible in his case for the condition found. He thought he was able to demonstrate a definite valve action just below the distended portion. This idea of the valve-formation, as the chief etiological factor in the disease, is shared by many others. Roser, for instance, describes several different ways in which a valve may be formed in the intestine and has demonstrated conclusively that under certain circumstances it is actually

accomplished. The idea of the obstruction from valve-formation is that generally accepted by many of the Continental authors. Pressure from neighboring organs, adhesions, etc., have been suggested by others as possible explanations.

3. A tonic contraction or spasm of the circular fibers in the lower part of the intestine. This is the prime cause, the dilatation and hypertrophy following as a result. Fenwick, Gee, Hitchins, and others report cases in which a definite spastic contraction of the sphincter ani was observed associated with fissures in the anal margin.

Unfortunately, none of these theories explains all cases, and in a goodly number of those cases that have been reported, no satisfactory explanation of the phenomenon observed has been found. The clinical picture is one that is usually easily recognized and little need be said about it.

The surgical treatment has been only fairly satisfactory owing largely to the fact that the patients are usually in poor physical condition and hence bad surgical risks. Dowd points out that surgical treatment is more successful than medical in the proportion of about 6 to 4. Many forms of surgical treatment have been recommended. The operative mortality in recent years has undoubtedly improved, owing to the more general use of rational surgical procedures. His table of 136 cases shows a mortality rate of 28.7 per cent, a very satisfactory showing, all things considered.

Dowd divides the operative procedures into three main classes: (1) those for whom only a colostomy or an appendicostomy was done; (2) those for whom there was some semi-palliative procedure done, such as short-circuiting, colopexy, relief of volvulus, colon-plication, etc.; (3) those for whom more or less of the colon was resected. The first two groups which are chiefly palliative need not be considered further, as they are not advised except in cases where for some reason or other a more radical curative procedure is contra-indicated. The present attitude of mind among most surgeons is in favor of removing as much of the enlarged colon as seems advisable or practicable. In order to accomplish this, three main methods have been employed: (1) The so-called one-stage operation, removal of the dilated portion of the colon and reuniting the divided ends intra-abdominally by some one of the accredited methods of intestinal anastomosis. (2) The so-called two-stage method of intra-abdominal resection. There are many variations of this method, either with or without a preliminary colostomy for emptying and irrigating the colon before resection, and providing a vent thereafter. (3) Extra-abdominal resection, generally done in two or more stages, the so-called "Mikulicz" method. The portion of the colon to be removed may be delivered through a separate opening in the abdominal wall which is preferable, or through the original incision. In all probability, the last-named method is the one of choice in the majority of cases, since it is attended by a much lower mortality rate than the others, and since the ultimate results have proved quite satisfactory. It has the obvious disadvantage of taking a longer time to secure the desired result than some of the others, but, on the other hand, the proportion of cases of megacolon suitable for a one-stage resection is relatively small. The chief dangers in the operation are the poor condition of the patient, the risk of sepsis, since these colons are particularly foul, and the shock of the operation due to extensive resection.

As pointed out by Dowd, the so-called two-stage extraperitoneal resection of Mikulicz has not been up to the present time very

popular, but to the conditions that exist in this particular affection it seems perhaps better adapted than any of the methods of resection hitherto employed.

J. M. T. Finney.

ACUTE PLEURAL EMPYEMA

THE problems associated with acute pleural empyema loom large in the daily routine of the general practitioner, the internist, and the general surgeon.

Forty years ago the routine treatment was aspiration and the important detail was to aspirate the fluid without permitting air to enter the pleural cavity. The persistent chronic cases were treated by drainage, the tube being passed through one of the intercostal spaces.

Then came the practice of rib resection and drainage, the object being to secure more efficient and thorough emptying of the plural sac, using a larger tube and avoiding pressure necrosis of the ribs. This was regarded as a distinct advance and, indeed, it was. The tube caused less discomfort, and opportunity was afforded to remove masses of fibrin and thus shorten the period of convalescence.

The experiences of the training camps during the scourge of influenza,—which so frequently produced a virulent empyema,—that swept through America in 1918, and of the late war changed our views on many points relating to the pathogenesis and treatment of empyema, infected joints, and the infected abdomen.

The mortality rate was lowered by the return to the use of the aspirator, and a less frequent use of the drainage tube.

In civil practice the more common source of infection is undoubtedly the lung and the visceral pleura, although infection through the diaphragm is probably more frequent than is sometimes realized. Occasionally the original focus may be in the parietal pleura.

The presence of fluid in the cavity of the pleura is not difficult to recognize and yet from time to time, one hears of cases of *empyema necessitas* and of rupture into the bronchus followed by death from drowning. Delayed resolution of a pneumonia should always suggest the possibility of a pleural effusion as the cause, and a report from the nurse or the mother that there has been an attack of dyspnœa during the night should confirm the suspicion of lung compression. The point is so easily settled by a small exploring needle that one wonders why pleural effusion is ever overlooked.

An empyema differs from an abscess in the abdomen, for instance, in having one rigid wall. This fact makes it all-important that the pus should be removed before the visceral pleura becomes so thick that it prevents the lung from expanding and resuming its place against the ribs.

No doubt the variety of infection plays an important part in the prognosis and treatment, hence the value of a combined cytological and bacteriological examination of the fluid withdrawn. Aspiration, repeated several times if necessary, favors lung expansion and may be all that is required. If there is found to be a tendency to recurrence and chronicity, then is the time for drainage, but drainage with every precaution against infection from without, and for a limited period of time. Finally if the pleural sac is rendered sterile or nearly so by Dakin solution or other agents, closure of the opening without drainage gives admirable results in many cases, even in those in which aspiration is indicated, and may need to be repeated several times during convalescence.

The sooner these patients can be got out of bed and encouraged to move about in the fresh air the more quickly do they recover.

G. E. Armstrong.

THE MANAGEMENT OF GASTRIC AND DUODENAL ULCER

ONE of the most striking facts in connection with chronic ulcer of the stomach and duodenum is the number of earlier conceptions which have undergone great changes during the past few years. The evolution of ideas with regard to such ulcers has been synchronous with the surgical treatment of the disease, and it is doubtful that the knowledge thus obtained could otherwise have been acquired. In spite of the present wealth of accurate information, however, many questions are still unsettled and consistently satisfactory treatment of the disease cannot be expected until they are solved.

Although the cause of ulcer is not clearly understood, probably because of its complexity and the close relationship to the neurogenic system, it is significant that it is rather generally agreed that the selective localization of pathogenic bacteria is, as shown by Rosenow, a most important factor. Until the cause of chronic ulcer is sufficiently understood so that it may be recognized and adequately dealt with, the diagnosis and treatment of the disease are the chief concern.

The great value in the close association of the well-qualified internist, roentgenologist, pathologist, and surgeon is particularly well exemplified in the interpretation of gastric symptoms, and their composite opinion will be correct in 95 per cent of cases. In no other intra-abdominal disease has diagnosis become so accurate as in chronic gastric and duodenal ulcer, and it is to the screen and the plate, in experienced hands, that a large measure of the success in attaining this efficiency must be accorded.

Such an efficient method has led to one difficulty, namely, the tendency to forget the patient and his complaint in the presence of visible abnormalities or disease. The danger of such an attitude has been emphasized in several recent papers and is a timely warning in view of the rather large margin of error in the roentgenological diagnosis of ulcer in the hands of the inexperienced. The opinion of the well-trained clinician, who is able properly to evaluate special diagnostic aids and is familiar with the results of methods of management, continues to be the most reliable basis on which to determine the best course for the patient.

The principles of treatment of gastric and duodenal ulcer are becoming quite generally agreed on. However decided surgeons may be that chronic duodenal and gastric ulcers are surgical conditions, they also recognize that there is a stage in the development of the lesion during which it may well be subjected to medical management alone. The number of early ulcers which heal spontaneously or are permanently cured by medical means can not be determined because of the difficulty of recognition. It will be an even greater problem to learn why some ulcers heal and why others, under apparently similar conditions, become chronic. Most surgeons agree that every early ulcer should have a thorough trial of cure under medical régime, if the patient can afford the time and expense necessary. When, in spite of treatment, an ulcer becomes chronic and recurrent, the best immediate and late results are achieved by surgery.

Surgeons are not in complete agreement as to the best method of surgical management. This is fortunate since the difference of opinion will bring out the truth more rapidly

than will blind adherence to a standard method of treatment. In any discussion of the relative merits of the different operations for gastric and duodenal ulcer, it should not be forgotten that gastro-enterostomy and its results brought about and justified the adoption of surgical measures in the treatment of ulcer. Another point which is often overlooked is that gastric and duodenal ulcers are distinct entities and should always be so considered, particularly from the standpoint of their surgical management.

A further suggestion might be made, that the surgical management of ulcer should always be discussed on the basis of size, situation, character, and complications. An operation which may be clearly indicated for one ulcer may be quite ineffective in another. The trend of development in the surgical management of chronic gastric and duodenal ulcer has been toward more radical measures.

The desirability of excising a gastric ulcer, unless local conditions contra-indicate, is now quite generally accepted and in ulcers which have been associated with bleeding the wisdom of destruction or excision is obvious. Gastric resection for gastric ulcer and pylorectomy or partial duodenectomy for duodenal ulcer is now being advocated by British and continental surgeons. Such procedures mark the limits of surgery, at least from a technical point of view. Whether the ultimate results of partial gastrectomy for ulcer will prove to be better than the results which follow local excision of the lesion by knife or cautery combined with gastro-enterostomy or pyloroplasty is a question. If the results are better, the question arises whether they are sufficiently so to offset the added risk of the radical operation, especially in inexperienced hands. For sound reasons the excision of the duodenal ulcer combined with the pyloroplasty of Finney is gaining favor with the surgical profession when it can be done without more risk than gastro-enterostomy with cautery or knife excision.

The subsequent course of patients operated on for gastric ulcer is not so satisfactory as the course of those operated on for duodenal ulcer. The subsequent death rate in duodenal ulcer is not higher than the death rate in the general population of similar age and sex, but the subsequent death rate following operations for gastric ulcer is three times the average death rate in a corresponding group of persons in the general population. Gastric ulcer is a much more serious malady from all standpoints than duodenal ulcer, and the fact may be emphasized that these diseases should always be considered and discussed independently.

The liability of cancer after operations for gastric ulcer (a liability which is present after all types of operation, including gastric resection), the occurrence of secondary ulcers which may also be sequels to any gastric operation, postoperative hæmorrhage, and the varying results in apparently identical cases subjected to the same treatment, are only a few of the questions, further knowledge of which will be important to this ever-interesting subject.

DONALD C. BALFOUR.

CORRESPONDENCE

CANCER OF THE AMPULLA OF VATER

To the Editor: Since the publication of my article on "Cancer of the Ampulla of Vater," in the June, 1921, number of SURGERY, GYNECOLOGY AND OBSTETRICS, my attention has been called by Dr. Gustav Pallin, surgeon to the University of Lund, to an excellent article of his in Bruen's *Beitraege zur klinische Chirurgie*, cxxi, No. 1, "Das Carcinom des Ductus hepatico-choledochus und seine chirurgische Behandlung." In this article Pallin refers to several cases of cancer of the ampulla of Vater treated by radical operation which I had failed to find in the books of reference at my disposal. I, therefore, take pleasure in summarizing the cases reported in Pallin's article, thus rendering my article more complete and at the same time acknowledging the work that Pallin has done.

CASE 1. Operated upon by Rixford in 1901. Cholecystostomy. Operative recovery 4 months later. Recurrence.

CASE 2. Operated upon by Voelcker in 1904. Transduodenal excision with hepatic drainage. Died in 2 days.

CASE 3. Operated upon by Morian in 1908. Transduodenal excision with cholecystojejunostomy. Operative recovery. Later metastasis.

CASE 4. Operated upon by Akerblom in 1912. Transduodenal excision with cholecystostomy. Died in 9 days.

CASE 5. Operated upon by Hirschel in 1913. Resection of duodenum; end-to-end anastomosis; resection of part of pancreas; gastro-enterostomy. Well after 1 year. Apparent recurrence.

CASE 6. Operated upon by Clermont in 1913. Transduodenal excision. Died.

CASE 7. Operated upon by Docq-VanPsever in 1914. Transduodenal excision. Operative recovery.

CASE 8. Operated upon by Docq-VanPsever. Transduodenal excision. Died on fourth day.

CASE 9. Operated upon by Wrede, in 1914. Transduodenal excision. Operative recovery.

CASE 10. Operated upon by Wrede in 1914. Transduodenal excision. Died.

CASE 11. Operated upon by Wrede in 1905. Transduodenal excision. Drainage of common duct. Operative recovery.

CASE 12. Operated upon by Akerblom. Transduodenal excision. Cholecystectomy. Died in 2 days.

CASE 13. Operated upon by Lundblad in 1919 Transduodenal excision. Died.

Three other cases by W. Mayo, Riecel and Czerny, died following operations or from recurrence.

ROBERT M. LEWIS, M.D.

Baltimore.

PRE-OPERATIVE PREPARATION OF PATIENTS WITH OBSTRUCTIVE JAUNDICE

A CORRECTION

In the article by Dr. Waltman Walters in the December, 1921 issue of SURGERY, GYNECOLOGY AND OBSTETRICS, line 40, page 655, third paragraph, should be corrected to read "from 20 to 34 hours after the removal of the." M. H. MELLISH, Editor

Rochester, Minn. *Mayo Clinic*

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS ON GYNECOLOGY AND OBSTETRICS

IN a long preface of 6 pages Roberts and Kelly[1] mention the influence of the war, the necessity for massage, and the teaching of early American authors on fractures. An outline summary of the material included in this new edition presents the authors' views on fractures, and the twenty-fourth point of the summary, which advises that "Joint fractures should not be kept immobile longer than one or two days; careful passive and active movement usually should be allowed within the first few days" might well be said in large type.

The first 138 pages are devoted to general remarks on fractures and are full of meaty material set down in a fashion which invites easy reading. The general chapter on treatment is particularly good; warning is again made against untrained operative interference on fractured bones. The use of the Lane plate is favored. One is pleased to find the meaningful term "open and closed fracture" used in the text.

There is much lacking in the description of the mechanism of fracture that has already found acceptance in the literature of the subject. Also the description of the symptoms of fracture fail to lay sufficient stress on the importance of localized tenderness and pain. Fractures of the carpal bones are given scant space. Regarding the valuable constant traction treatment for metacarpal and phalangeal fractures, no illustrations are given and little is said. It is to be regretted that there is not one specific reference to the literature in the whole book.

The remarks on the use of the X-ray in diagnosis and as a correction of treatment are good. A chapter on epiphyseal separations is helpful. After the discussion of treatment of fractures of important bones there is given a summary to bring out the points requiring attention. Obstetric fractures are allotted a short chapter at the close of the book, followed by a final one on industrial and war fractures. By war fractures, of course, is meant projectile fractures, caused by the projectiles fired from the weapons of war. There are many ordinary closed fractures among soldiers during war times which are exactly like civil fractures in peace time. A criticism might be made of the attempt in an authoritative textbook to deal with projectile and industrial fractures in so inadequate a space.

From a general viewpoint the grouping of illustrations and the reproduction of roentgenograms are excellent. In the first third of the volume, however, many of the roentgenograms fail to betray to the readers' eye the existing lesion; possibly it was evident to the authors in the original plates. The photographs of methods of treatment, except operative treatment, and especially those of specimens, are clear and businesslike. One photograph of the same leg with a Buck's extension applied is reproduced three times. Both students and practitioners will welcome this up-to-date edition with its wealth of illustrations. KELLOGG SPEED.

THIS little book,[2] now in its third edition, presents a concise and correct account of the more important facts of regional anatomy. The text is lucid and the material presented has been carefully selected. The author has wisely chosen to confine his attention to the structures and relations of greatest practical importance, emphasizing and elucidating them by brief references to their clinical applications, and has left to textbooks of surgery the non-anatomical details which encumber most texts of surgical anatomy.

The book would, however, have a greater field of usefulness if the illustrations were of better quality and furnished in greater number. Moreover, the author continues to use the old English terminology and has not even seen fit to include the B. N. A. terms in parenthesis. Since the Basle Anatomical Nomenclature is now employed in nearly all the larger texts and atlases of anatomy used in this country, American medical students are more familiar with the new than with the old terms and the usefulness of the book has thereby been considerably impaired. S. W. RANSOM.

THE work[3] before us is brimful of just the information needed by the radiologist for the rational analysis and interpretation of the X-ray plates of bone and joint disease. Liberal space is devoted to fractures, but the more important and highly valuable portion of the work is the major section devoted to the elucidation of Baetjer's well-known philosophy of bone shadow interpretation.

[1] TREATISE ON FRACTURES IN GENERAL, INDUSTRIAL AND MILITARY PRACTICE. By John B. Roberts, A.M., M.D., F.A.C.S., and James A. Kelly, A.M., M.D. 2d ed. revised and entirely reset. Philadelphia and London: J. B. Lippincott Co., 1921.

[2] A MANUAL OF SURGICAL ANATOMY. By Charles R. Whittaker, F.R.C.S. (Ed.), F.R.S.E., 3d. ed., revised and enlarged. New York: William Wood & Company, 1921.

[3] INJURIES AND DISEASES OF THE BONES AND JOINTS. Their differential diagnosis by means of the roentgen rays. By Frederick H. Baetjer, M.D., and Charles A. Waters, M.D. New York: Paul B. Hoeber, 1921.

The work abounds with axiomatic truths which cannot be too often emphasized. "Roentgenology is not a picture process but a medical procedure based upon careful analysis and logical deductions from the shadows observed upon a plate and the translation of these shadows into pathological terms. . . . The ability of the roentgenologist depends not so much upon his technical skill as upon his familiarity with the general problems of medicine and surgery."

American roentgenology is proud of this work which is bound to make itself felt very promptly in greatly improved averages of success in the X-ray diagnosis of bone and joint lesions.

JAMES T. CASE.

DELAYED in publication by the World War, this, the second edition of the *American Year-Book of Anæsthesia and Analgesia*[1] covers the advances in the science and practice of anæsthesia and analgesia during 1917–1918. The collected papers and researches are contributed by eminent authorities of the allied professions who are vitally interested in current advances. The several chapters devoted to anæsthesia at the front and war surgery of the base and reconstruction hospitals will be found valuable for future military use, as well as in industrial surgery. Of special interest are the studies in the pharmacophysiopathology of anæsthesia and analgesia which have a direct bearing on the clinical handling of patients submitting to operation under narcosis. Contributions on the newer local anæsthetics, their pharmacology, comparative toxicity and value in local anæsthesia in general surgery and in dentistry and oral surgery are presented as well as pertinent papers on anæsthesia and analgesia in obstetrics which are of practical value.

An added feature of this edition is the cumulative index of the world literature for 1917–1918 which is developed under subject headings, and which makes a convenient bibliography for reference.

ISABELLA C. HERB.

GENERAL pathology,[2] conceded to be the foundation of medical science and practice, is nevertheless, likely to be neglected in the reading of the average clinician. The work by Oertel is an admirable outline of the subject, clear, concise, and readable. Pathological processes are interpreted as physicochemical cell alterations and disturbed cell relations which follow common biological laws and which, in most instances, find definite anatomical expression. The attempt is made to present pathological anatomy and histology in such a manner that the processes of disease may be clearly visualized. The historic development of present ideas is traced.

The volume, intended as an introduction to the study of medicine, covers a broad field in general outline. It contains only 357 pages. An extensive bibliography has been omitted; there are no illustrations. For use as a text supplementary laboratory experience is assumed. The discussion of etiology comprises 160 pages, possibly a disproportionate number; pathological anatomy, histology and pathogenesis are treated in 189 pages. Disposition and heredity receive unusually clear and detailed discussion.

The value of the work lies chiefly in its conciseness and clearness of expression, in its interpretation of pathology as changes in cells and their relations produced in accordance with biological laws, and in its emphasis on visualization of the pathological picture. This book should prove stimulating both to the graduate and to the student of medicine.

W. H. NADLER.

WHEN as students in medical school we were attempting to lay a broad foundation for our medical knowledge, to systematize the numerous ideas that were thrown at us, pell-mell as it were, in different clinics, and when as seniors we were trying to encompass all knowledge in a heroic attempt to best our competitors in hospital examinations, two textbooks stood out in our minds as particularly helpful and valuable—Osler's *Medicine* and Stewart's *Manual of Surgery*.[3]

The appearance of the fifth edition of the latter, published after the death of its gifted author, with the assistance of Dr. Walter Estell Lee, makes us realize anew the sense of personal obligation we always felt to Doctor Stewart for his concise, clear cut, and admirably simple presentation of the principles and practice of surgery.

The edition in question is considerably larger than its predecessors, due to numerous additions, and to a different "make-up." It has been carefully brought up to date by the inclusion of the lessons learned from the war—particularly those concerning the treatment of infected wounds of the various regions of the body, the treatment of fractures, of nerve injuries, and of shock. The sections dealing with plastic surgery, with the treatment of empyema, with the surgery of the abdomen, reflect the ideas of a surgeon of skilled judgment, thoroughly abreast with the advances being made in varied fields.

No textbook, particularly in medical fields, is perfect. The inclusion of old illustrations, such as that illustrating obsolete methods of nerve anastomosis, of obsolete procedures such as the majority of those mentioned in the treatment of trigeminal neuralgia, the omission of mention of the ordinary Thomas splint for the treatment of fractures of the lower extremity, or of the Jones modification of the Thomas arm splint for fractures of the humerus, the failure to mention the importance of a metabolic rate determination in the diagnosis of

[1] THE AMERICAN YEAR-BOOK OF ANESTHESIA AND ANALGESIA, 1917-1918. F. H. McMechan, A.M., M.D., Editor. New York: Surgery Publishing Company, 1921.

[2] GENERAL PATHOLOGY; an introduction to the study of medicine. By Horst Oertel. New York: Paul B. Hoeber, 1921.

[3] A MANUAL OF SURGERY; for students and physicians. By Francis T. Stewart, M.D. 5th ed. Philadelphia: P. Blakiston's Son & Co., 1921.

a toxic goiter, are illustrations of small imperfections well-nigh unavoidable. We feel that a little more definite reference to sources, to those who have contributed largely in special fields would have added to the value of the volume.

Minor omissions and slight imperfections, however, do not affect our belief that the author has left behind him an enduring monument, both to his ability as a writer, and to his skill and judgment as a surgeon. S. L. Koch.

BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

Indispensable Orthopædics; a Handbook of Treatment. By F. Calot. 2d English ed., translated from 7th French ed. By A. H. Robinson, M.D., M.R.C.S. 2 vols. St. Louis: C. V. Mosby Company, 1921.

Aids to Operative Surgery. By H. C. Orrin, O.B.E., F.R.C.S.(Ed.). New York: William Wood & Company, 1921.

Greek Medicine in Rome; the Fitzpatrick Lectures on the History of Medicine Delivered at the Royal College of Physicians of London in 1909–1910 with Other Historical Essays. By The Right Hon. Sir T. Clifford Allbutt, K.C.B., M.A., M.D., F.R.C.P., etc., New York: The Macmillan Company, 1921.

Essays on Surgical Subjects. By Sir Berkeley Moynihan, K.C.M.G., C.B. Philadelphia and London: W. B. Saunders Company, 1921.

Life and Times of Ambroise Paré (1510–1590) with a New Translation of his Apology and an Account of his Journeys in Divers Places. By Francis R. Packard, M.D. New York: Paul B. Hoeber, 1921.

The Technic of the Chicago Lying-In Hospital and Dispensary. By Joseph B. DeLee, M.D., 1921.

Index-Catalogue of the Library of the Surgeon General's Office, United States Army. Authors and Subjects. 3d series, vol. ii,—Arnal-Blondlot. Washington: Government Printing Office, 1920.

Report of the Scientific Work of the Surgical Staff of the Woman's Hospital in the State of New York. Edited by George Gray Ward, Jr., M.D., F.A.C.S., vol. iii, 1920.

A Textbook of Midwifery for Medical Schools and Colleges in India. By Kedarnath Das, C.I.E., M.D. Calcutta and Simla: Thacker Spink & Company, 1921.

The Practice of Urology; a Surgical Treatise on Genito-Urinary Diseases Including Syphilis. By Charles H. Chetwood, M.D., LL.D., F.A.C.S. 3d ed. New York: William Wood & Co., 1921.

Modern Italian Surgery and Old Universities of Italy. By Paolo di Vecchi, M.D. Foreword by George D. Stewart, M.D. New York: Paul B. Hoeber, 1921.

Lippincott's Nursing Manuals. Surgical and Gynæcological Nursing. By Edward Mason Parker, M.D., F.A.C.S., and Scott Dudley Breckinridge, M.D., F.A.C.S. 2d ed. revised. Philadelphia and London: J. B. Lippincott Company, 1921.

Les Fistules Jéjuno-Coliques par Ulcère Perforant après Gastro-Entérostomie. By Docteur Georges Loewy. Paris: Imprimerie E. Desfossés, 1921.

Collected Papers of the Mayo Clinic, Rochester, Minnesota. Edited by Mrs. M. H. Mellish. Vol. xii, 1920. Philadelphia and London: W. B. Saunders Company, 1921.

Diagnostische und therapeutische Irrtulmer und deren Verhuetung. Frauenheilkunde und Geburtshilfe. By Prof. Dr. J. Schwalbe. 5 monographs. Leipzig: Georg Thieme, 1921.

Obstetrics and Gynæcology. Edited by John S. Fairbairn, M.A., B.M., B.Ch.(Oxon.), F.R.C.P.(Lond.), F.R.C.S. London: Oxford University Press, 1921.

Clinical Diagnosis for Students and Practitioners. By F. DeQuervain. 3d English ed. translated from the 7th ed. by J. Snowman, M.D. New York: William Wood & Co., 1921.

Atlas for Electrodiagnosis and Therapeutics. By F. Miramond de Laroquette, M.D. Authorized translation by Mary Gregson Cheetham. Foreword by Robert Knox, M.D. New York: Paul B. Hoeber, 1921.

Diagnosis by Transillumination. Chicago: Cameron's Surgical Specialty Company, 1921.

Vice and Health Problems—Solutions. By John Clarence Funk, M.A., LL.B. Philadelphia and London: J. B. Lippincott Company, 1921.

Traite d'Urologie. By G. Marion. 2 vols. Paris: Masson et Cie, 1921.

A Textbook of Surgical Anatomy. By William Francis Campbell, A.B., M.D., F.A.C.S. 3d ed. revised. Philadelphia and London: W. B. Saunders Co., 1921.

The Life of Jacob Henle. By Victor Robinson, M.D. New York: Medical Life Company, 1921.

The Spleen and Some of Its Diseases Being the Bradshaw Lecture of the Royal College of Surgeons of England, 1920. By Sir Berkeley Moynihan. Philadelphia: W. B. Saunders Company, 1921.

Heart Disease and Pregnancy. By Sir James MacKenzie. London: Oxford University Press, 1921.

Ephraim McDowell "Father of Ovariotomy" and Founder of Abdominal Surgery. With an appendix on Jane Todd Crawford. By August Schachner, M.D., F.A.C.S. Philadelphia and London: J. B. Lippincott Company, 1921.

Annexites noninfectieuses; Maladies de l'Ovulation. By Dr. Paul Dalché. Paris: L'Expansion scientifique Française, 1921.

Pneumoperitoneal Roentgen-Ray Diagnosis. (A Monograph with Atlas.) By Arthur Stein, M.D., F.A.C.S., and William H. Stewart, M.D., F.A.C.P. Troy, New York: The Southworth Company, 1921.

AMERICAN COLLEGE OF SURGEONS

REPORT OF THE HOSPITAL CONFERENCE HELD AT THE CLINICAL CONGRESS OF THE AMERICAN COLLEGE OF SURGEONS OCTOBER 24, 1921, PHILADELPHIA[1]

MORNING SESSION—THE PRESIDENT, GEORGE E. ARMSTRONG, M.D., PRESIDING

HOSPITAL STANDARDIZATION, ITS INCEPTION, DEVELOPMENT, AND PROGRESS IN FIVE YEARS

BY FRANKLIN H. MARTIN, M.D., CHICAGO
Director-General of the American College of Surgeons

YOU have all undoubtedly asked yourselves why this program of the American College of Surgeons has been received with so much approval, why it has attracted so much attention, why it has had so much influence.

Scientific medicine is developing so rapidly that of necessity it is reducing the number of the medical profession in proportion to the people they have to care for. Medicine, therefore, is becoming more wholesale and institutional, less retail and domiciliary. That of necessity has placed an enormous responsibility upon the hospital, because the hospitals must be the institutions in which the wholesale or group medicine is practised.

The American College of Surgeons is responsible for the standardization of hospitals, because in its early days it found it necessary to standardize its own environments. For instance, in making a standard for admission to fellowship, it was necessary that we ask the candidates to furnish us the reports of fifty major operations and fifty minor operations, in lieu of an examination. These reports began to come in. They were on all kinds of forms. There was absolutely no standard record on which they could give us the evidence of their own ability to practise surgery. Soon we were asked from every direction to furnish a standardized system of records, to suggest a form upon which these records could be given to the College. We attempted to do that. A committee was formed for the purpose, and we furnished, wherever required, a set of standardized records. Then what happened? The hospitals—a great many of them—began to ask us if we could not in some way furnish these same standardized records or forms to them, which, of course, we were very glad to do.

That was the first step in the standardization of hospitals. Then, early during the war, it became necessary for us to have some other minimum standards that would apply to the hospitals in the camps, the army hospitals. And in Washington was called a conference of medical officers and we discussed a minimum standard for military hospitals.

After that, in one year, the American College of Surgeons formulated its minimum standard for hospitals. Is there anything that a hospital can leave out of that standard and be a hospital? First, records; second, staffs, with staff meetings; third, a competent and honest staff; fourth, laboratories. That is practically the minimum standard of the American College of Surgeons. Any hospital that cannot furnish this minimum standard is not a hospital. It is the very minimum thing we could ask of hospitals to do in order to have us recognize them as hospitals.

That led immediately to a survey of the hospitals to ascertain which hospitals met this minimum standard. For the last three or four years surveyors employed by the College have visited all of the hospitals of one hundred or more beds in the United States and Canada.

SUMMARY OF YEARLY REPORTS

In 1918, of the 692 general hospitals of one hundred or more beds, in the United States and Canada, 89 met the standard; in 1919, 198; in 1920, 407, or 57 per cent; and this year 568, of a total of 761 hospitals, or 74 per cent, meet the standard of the College.

[1] Due to lack of space, the editor has taken the liberty of omitting portions of various addresses.

1921 REPORT

Today, we have the pleasure of presenting to you our annual report on the hospitals of North America, having one hundred or more beds. This list contains the names of such general hospitals in the United States and Canada as have met the minimum standard. In this list, a certain number of institutions are designated with a star. This group includes those hospitals which, when visited, had adopted the fundamental principles of the minimum standard, but which at that time had not had sufficient opportunity to develop all of them to a degree meriting the fullest approval. The hospitals listed without a star instituted these measures at an earlier date, and consequently received the benefits of a longer experience in the workings of the program and a broader conception of its application.

THE FUTURE PROGRAM

The program of the future will be extended to include all general hospitals of fifty or more beds in the United States and Canada. Of these institutions, many of which have been visited, a large number showed a working knowledge of the minimum standard and evinced an active desire to co-operate. The percentage of these meeting the standard on first visit compares favorably with the percentage of the larger hospitals approved on first inspection. If proof were needed of the universal application of the minimum standard, the acceptance by the smaller hospitals would furnish it. Stressing only broad fundamentals, the minimum standard molds itself to meet specific needs, nowhere impeding initiative or fettering judgment. Rightly conceived and carried out, it makes the hospital the proved guardian of the community health, rendering scientific service to all.

WHY THE COLLEGE MUST CONTINUE THIS SURVEY

Now, surgeons and hospital superintendents, what is the future program of hospital surveys other than I have indicated here? Why should the American College of Surgeons continue this work? It should continue the work because it is the measure that the College has of the fitness of the men who we expect will enter the College. It is impossible for the College to do anything but to take the leadership in the question of its own standard. It is something that we cannot delegate to someone else. Therefore, as long as the American College of Surgeons is in existence, I can see that it will be the duty of the American College of Surgeons—duty to itself—to see that the environment in which its candidates do their work is of the proper kind. Therefore, this work will have to go with the College. The success of this work, I believe you will all realize, lies in the fact that back of it is a great ideal for service and honesty. And this is the reason the program has succeeded far beyond our expectations.

HOSPITAL STANDARDIZATION FROM THE VIEWPOINT OF THE MEDICAL PROFESSION

By ROBERT L. DICKINSON, M.D., New York

MILD as this meeting looks, Mr. Chairman, it represents a revolution that has come very quickly and very sanely. Years ago Dr. Codman asked of the medical profession and of hospitals: "Do you dare show us your end-results?" A Dr. Martin takes up this challenge and with a Bowman and a Moulinier puts it into effect, and in working order, on a surgically sane basis. Hospitals have been answering that challenge ever since and their answer to the challenge represents the effect of hospital standardization.

Hospital standardization might belong to the American Hospital Association, that wonderfully able body represented here so fully. But standardization of the surgeon belongs to the surgeon.

Now, Codman saw years ago that you can have a surgical accounting as you can have any accounting. If it could be done in government, if it could be done in finance, it can be done here. Honor, honesty, and efficiency can be measured.

Let us come to the staff review. I take it the College—I am not speaking officially for them—I take it the College has had this to say: "Yes, we can give you a sample laboratory list, but as to what constitutes a staff review, you had better experiment a while yourselves. Start the machinery. Try it out." I think the time has come for the College to give us a sample procedure for staff meetings, adaptable to different types of hospitals.

One other pitfall: Here is a surgeon knowing that he should not have a mortality in his active service, we will say, of more than 4 per cent, and who therefore refuses to endanger his mortality record by certain operations. I do not want

any man to refuse to open my abdomen because he might exceed his death-rate. You have to have fearless surgery today.

Now, on the other hand, the reckless experimenter with human life must be curbed. Some of the greatest surgeons are the most reckless. How are we going to take counsel in any of these great things unless we do as Codman has told us to do? We should charge up an error of judgment or of technique when indicated and, in other cases, wipe that physician's record clean from censure who operates upon a patient *in extremis*, hoping to save a life. In other words, this matter of fair surgical mortality must be formulated and I think the College is the authority to act.

The hospital trustee comes to me and says: "You know my interest in this matter. What should our records be? What is a fair mortality? What is a fair infection in clean cases?" The College has given us certain averages. What would be a normal average? This is another place where the College might compile and publish interesting suggestions. In my opinion, the time has come to define a few other minimum standards.

Another point regarding the staff meeting: It should be for mutual stimulation and encouragement. Nothing is gained by turning it into a fault-finding clinic. We must bring in individual triumphs, as well as failures. Then the staff meeting will make for better effort.

When all is said and done, gentlemen, the whole story comes down to this: You cannot legislate these things. As the last speaker has said, the answer to all progress in medicine depends upon the elimination of the unfit, and the development of individual honor and competence.

THE HOSPITAL SURVEY OF THE COLLEGE IN 1921

By FREDERICK W. SLOBE, M.D., Chicago
Hospital Standardization Department, American College of Surgeons

IN January of this year, when the hospital program of the College for 1921 was evolved, it was decided to limit the survey to thirty months of hospital visiting. This was from necessity rather than from choice. Consequently, hospitals which were fully approved in 1920 were not revisited this year. Follow-up visits to these hospitals, however, were postponed only temporarily. Particular attention was directed toward those hospitals which either were not on the approved list last year or which were listed with an asterisk. In addition, as many as possible of the fifty-bed hospitals were visited also.

The survey was conducted through personal visits by a corps of seven hospital surveyors. These men—all physicians—were from medical schools and hospitals of widely separated sections of the country. They were given a course of training at the College headquarters, followed by survey work with experienced hospital visitors. This uniformity in training assured the College of uniform reports, which constitutes one of the essential features of the College program. Whether a hospital were in Maine, therefore, or in California, each institution was visited and surveyed on the same basis. Further, by visiting a large number of hospitals scattered over a wide range of territory, these surveyors obtained a general, rather than a local view-point. This policy of personal visits by relatively few, uniformly trained hospital surveyors is one of the most important elements of the College program.

There are certain difficulties experienced by hospitals in their endeavor to meet the standard of the College which merit special emphasis.

Relative to staff organization, one of the chief difficulties seems to be the adoption of a type of staff meeting which actually analyzes the clinical results. Slowness in developing a co-operative, group spirit among the physicians seems to be the chief hindrance. As this spirit develops, the purpose of the staff meeting becomes more nearly realized. In the average hospital a combined staff meeting is essential. Teaching hospitals, however, and other hospitals with highly specialized staffs, and hospitals having a staff membership of only one or two physicians, form certain exceptions to this rule. In such instances, departmental conferences, teaching clinics, and individual analyses take the place of the combined staff meeting.

The adoption of an official resolution prohibiting fee-division has been a second stumbling block in many hospitals. Hospitals which have been slow to respond may be divided into two groups. In the first group are institutions, in which, apparently, the practice has not been unknown and where, consequently, difficulty was expected. It was a distinct surprise, however, to meet opposition to passing such a resolution in

some hospitals of the second group, having a high ethical status in communities or sections of the country where the practice of fee-division is practically unknown. Some of these hospitals were very hesitant about passing resolutions condemning the practice. When they began to realize, however, that they served as powerful examples for other hospitals in which the practice was prevalent and that the College must apply a uniform policy toward all hospitals, they responded. That the viewpoint and stand of the College in this matter is amply warranted is evidenced by the impression gained by our hospital visitors, that the practice of fee-division is present to some extent in nearly every state and province, even though it may be practically unknown in some sections.

Case records are improving steadily although they still constitute the greatest difficulty in many hospitals. Two factors stand out most prominently in impeding the development of proper case-record systems in hospitals: first, the lack of proper interest in the case records by physicians and hospital executives themselves; second, the lack of internes. The first is just as important as the second, because even a full quota of internes without sufficient supervision will often fail to secure adequate records. When the hospitals do their share in supplying sufficient record facilities and personnel, and the staff members co-operate by exhibiting proper interest in supervising the records, most of the difficulties in this connection will be solved.

Laboratories have shown a similar steady improvement. There is a demand for laboratory equipment, technicians, and pathologists, which has been hitherto unknown. One handicap to the development of adequate laboratory service is the system of making a separate charge for each laboratory test performed. This difficulty has been obviated in many hospitals by establishing a flat-rate fee to include most of the usual laboratory tests. Tissue examinations should be included in this flat rate, otherwise it is difficult to obtain routine examination of all tissue removed at operation. Although the flat-rate fee may not be applicable in all hospitals and may be inadvisable in some, it has been of tremendous help to many hospitals in solving their laboratory problems.

Last year, out of the 704 hospitals in the United States and Canada having a capacity of more than one hundred beds, 407, or 57 per cent, were on the approved list. Of that number 193, or almost half, were listed with an asterisk.

This year, the total number of one-hundred-bed hospitals has grown to 761. Of this number 568, or 74 per cent, are on the list. Of these 568, 18 per cent, are listed with an asterisk, showing the great relative decrease in the number of hospitals listed with an asterisk this year. The asterisk has been used to indicate those institutions which, although they have instituted measures adopting the fundamental principles of the standard, have not developed them to their fullest efficiency at the present time.

Besides these larger hospitals, 704 of the fifty-bed hospitals were visited during the past 2 years. According to our records, there are about 875 of these hospitals, leaving about 150 which have not been visited. It is the hope of the College to visit all of these smaller hospitals next year, so that they may be included in the next approved list. The total number of hospitals visited by our hospital surveyors this year is 1,007.

The attaining of the minimum standard, of course, is not purported to be a resting place in the pathway of a hospital's progress. It is no ultimate standard. There are many things beyond. It does, however, contain the basic fundamentals and that, doubtless, is why so many hospitals have adopted it.

HOSPITAL STANDARDIZATION FROM THE VIEWPOINT OF THE HOSPITAL SUPERINTENDENT

By ALFRED K. HAYWOOD, M.D., Montreal
Superintendent, Montreal General Hospital; Representing Canada for the American Hospital Association

MODERN hospital administration has become a specialized profession within the past twenty years. Hospital administration today is not only a science, but a business. Those of us who have been hospital administrators for years realize that we are only at the beginning. Our hospitals stand for two purposes: they teach and they heal. It is not possible in every community that every hospital be a teaching hospital, but each one must be a healing hospital. If we hospital administrators are going to take our place in the community without a pretense, when we go out to financial men for aid, we must be in a position to show them the result of our work in black and white. We must prove by results that we are entitled to public confidence and support.

This procedure places a certain increase in expenditure on the hospital administrator. There was a time when we were quite content with a written report of an operation. But now we are not content with that. The majority of the reports are not legible. We must have a typewritten report. That means an extra stenographer and typewriter and extra equipment, and I can assure you that anything done to get 100 per cent of hospital standardization, as we have tried to do it, has meant increased expenditure to the hospital. But I can assure you, in addition to that, it has given us 500 per cent increase in results. A record for which we spent a thousand dollars a year was not worth 10 cents when 5 years went by, and we couldn't use it. Certainly the money we spent on records heretofore was absolutely useless. Now, we can get our records at any time and they are logical and contain every detail. We are considering putting in additional equipment and when the time comes that one of our surgeons seeks information we hope he may make use of it.

RECORDS—HOW LONG SHALL WE KEEP THEM?

This brings up the question, "How long shall we keep our records?" That has bothered a great many of the administrators of our hospitals. You cannot admit seven or ten thousand patients a year and keep a full record of all of them and expect to be able to house such records with the quarters that are available.

If our records are to be of the use they are expected to be, we cannot turn the patient out of the hospital without a very beautifully kept history. We turn our patient adrift as cured without the further knowledge at some late date whether or not the time and money spent on the cure of the patient will be lost. That consequently brings up the follow-up system. It is almost impossible for us to know that a patient has had proper treatment unless we use the follow-up system. And to conduct a follow-up system properly costs a great deal of money. As a rule that does not matter to the surgeon and to the attending men of the hospital.

The more a hospital administrator understands the difficulties of his attending staff, the more willing will he be to provide the staff with material or equipment to meet the hospital standard or for any other purpose that might be necessary. For that reason hospital standardization has indirectly brought the attending staff and the hospital administration much closer together.

STAFF MEETINGS

I think it has been conclusively proved that staff meetings properly run can be of immense benefit to the patient—to the patient first, because that is the ultimate object of our hospitals—and to the attending staff, second. How staff meetings are to be run is a question of opinion. One hospital superintendent says it is best to serve luncheon in conjunction with the meeting. When this is done fewer members leave the meeting for they hear things discussed with less loss of time. I have tried that plan myself and I find it has worked out wonderfully well.

If staff meetings are advantageous from the standpoint of our hospital administrators—and I am sure they are—and if staff meetings are a good thing for the attending staff and a success, why not let us have staff meetings for the rest of the hospital, for the matron of the training school, for the chief engineer, the housekeeper, the fireman? Why not have them meet and hear one another's troubles? They are all spokes of the same wheel, and I am convinced that the results of such meetings would be 100 per cent beneficial. There is no reason why the chief engineer, for instance, should not know something about what

is going on in the hospital. If such meetings are held, you will find that you have a spirit of cooperation among the workers, they work together, not against one another—a condition we used to see so often.

AUTOPSIES

Hospital administrators are anxious to have as many autopsies done in the hospital as possible. I think it is safe to say that the hospital administrator takes more personal interest in the securing of these autopsies in very many cases than the attending man.

Consent for postmortem examination can be secured, and I have been waiting for many a long day to have this opportunity to tell you just what we have been doing in the Montreal General Hospital. I am not doing it myself. I have nothing to do with it, but a member of my administrative staff has. Last year we secured permission for postmortem examination in 86 per cent of all deaths in the hospital, and this year to date we have secured permission in 87 per cent.

Hospital standardization brings to the administrator of the open hospital—I am not speaking on behalf of or against open hospitals—a controlling weapon over his attending staff. It does not necessarily need to be used as a weapon. But this much we do know that in open hospitals the work has not been of the same caliber as the work done in closed hospitals. The hospital administrator today in the open hospitals has in his hands with the aid of his committee of management a means, we will not call it a weapon, whereby he can come before his attending staff and tell them that they must meet the conditions contained in the minimum standard. He can say to them: "Yes, we will give you an open hospital, but in order to derive any benefit from this open hospital, you must meet our minimum standard."

HOSPITAL STANDARDIZATION FROM THE VIEWPOINT OF THE HOSPITAL TRUSTEES

By NEWTON E. DAVIS, D.D., Chicago
Executive Secretary, Conference Board of Hospitals and Homes of the Methodist Church

I COME to speak to you not from the standpoint of a trustee of a hospital but from the standpoint of the executive secretary of the Board of Hospitals and Homes of the Methodist Church which during the past year has had for its distinct service the program of standardizing its hospitals, making a survey of all the institutions within the bounds of the Board and seeking to find out the exact facts in relation to all of the work in our various institutions, especially of the church with which I am affiliated.

Up until a year and one-half ago, the hospitals operating under the Methodist Episcopal Church had no connection whatever one with the other. We had no Board. Since that time a Board has been organized, and the very first question that came before us for consideration was: "What standard shall we adopt and put into effect in regard to our hospital work?" There was only one answer to that—the minimum standard adopted by the American College of Surgeons. That is the best there is at the present time. Whenever we do see a better plan than that adopted by the American College of Surgeons, we shall add that to our already adopted program.

BOARDS OF TRUSTEES

In making a survey of our hospitals during the past year, 65 operating institutions, we have to begin back with the board of trustees, and we find some very interesting facts in our survey. Now, there are four kinds of boards of trustees, inasmuch as there are State institutions, municipal institutions, private institutions, memorial in character more or less, and also institutions operating within the bounds of some one of the denominations. So we have practically four kinds of boards of trustees. The State hospitals deal with their trustees through their State-appointed officers and trustees; the municipal hospitals, through officers and trustees appointed by the municipality; and the private hospitals are largely run by physicians with particular objectives in mind, memorial hospitals being private hospitals which have been built as memorials for families or for a group of people. We have different objectives in each group.

Now I will take up our own church hospitals. For instance, in an organized society, we have a body of men, the laity and missionary people, who want a hospital and want the church to get back of it. The important objective of any of these hospitals is the same, that is, that the patients shall have the very best kind of service rendered to them, from the diagnostic standpoint, the standpoint of treatment, or whatever it may be.

When we come to the standardization program, one of the first things that we find is that we have

to standardize a lot of boards of trustees. There are as many and varied kinds of ideas among boards of trustees as to what is the standardization program of the American College of Surgeons as there are among some other classes of folks who are non-medical practitioners. And we have had some very interesting sessions with men who for years have been president and secretary and treasurer of boards which have had very little to do with the hospital program. We have had this question asked many times: "Who are you? What does this mean anyway?" Most of them think it means expenditures of money, and it does. But without expenditure of money, we can never get to any place in the world. And I have been very frank to say to these members of our trustees: "You have run the institution on a cheap plan and you will have a cheap result." It means that you will have to expend more money and the best results cannot be secured without putting into it an adequate amount of money. And the boards of trustees of many of our institutions are very unconscious of the fact that none of our institutions can turn out the best product unless they provide conditions which are favorable.

CO-OPERATION OF TRUSTEES AND STAFF

So we face this problem. Many of our trustees have never been in close contact with the staff. They do not know what the staff wants to do. They do not know what a case record looks like. It is absolutely unreadable to them. And so you must educate the board of trustees to know what a really-readable chart is and what kind of an analysis should be made in order that patients should have the very best means of diagnosis and the very best service rendered them.

FINANCIAL INTERESTS

Another feature directly concerns the Board of Trustees. They are tremendously interested in the financial interests of the hospital. I know one instance where a board of trustees had notes at the bank amounting to fifty-five or sixty thousand dollars, they were running behind in their current expenses, they did not know just how to meet them, or where they were going to get the money to buy all the equipment that the hospital was calling for. The proposition came up of a new staff organization in the hospital, which would entail the expenditure of an additional amount of money. Could they afford to add additional expense to the already great burdens in order to establish a standardized staff? And in organizing that standard staff, the plan was to determine and specialize the entire staff development. And the president of the Board of Trustees said frankly, after he had been in close contact with the chief of staff: "We cannot afford not to put in the additional equipment, to put in all the standard requirements, regardless of the extra expenditure of money that it does entail!"

Another instance: here is a hospital with a board of trustees which during the past years has not been making any reports to anybody. They have not been responsible to anybody. This board of trustees has been a unit in itself as a hospital, not making a report to any city or State. But somebody else comes along—the American College of Surgeons—and says to the surgeons of the staff: "You do not meet the requirements." A man from the outside steps in and says: "Can we see your hospital records? Can we examine your laboratories and equipment and see what you are doing?" If the surgeons and physicians in your community are to be held responsible for the results of their services in the institution, then the responsibility for that must come back to the board of trustees and also to the people outside who furnish the money to keep the institution going.

LAYMEN PLEASED WITH PROGRAM

We started in to adopt the whole program and the result has been that the boards of trustees are doing their duty toward their institutions and toward the community; whereas a year and a half ago they were letting the staff attend to responsibilities; today they have a larger view of their problem, and a more intelligent appreciation of the work that the institution is trying to do for the City, the State, and the Church.

There is one more word I want to bring to you. I believe that the body of laymen throughout the entire country are tremendously pleased with this great program. Why should they not be? As business men asking for the best results, they could do no better than adopt the program of the American College of Surgeons. A man can only sell something if he has it to sell. He cannot sell what he does not have in the shop. So the doctor who says, "I can do certain things," but cannot produce the goods does not last very long. We have had some non-medical practitioners who have said: "We will close your doors unless we can bring in our patients, regardless of your rules and regulations." The State can hold the board of trustees responsible to the State. They have not gone that far yet. But the State has a responsibility as to what the board of trustees

does, and the responsibility for every case that comes into the hospital comes back to the trustees in the end. If that is so, then the other truth is self-evident that no board of trustees can allow practitioners to come into the hospital who cannot give proper diagnosis or proper treatment or do proper service. They must meet the requirements. And I am sure I speak this morning for a very large number of people and a large number of institutions, and I am very glad, indeed, that the doctors of the American College of Surgeons have made up this program during the past 3 or 4 years and have established a standard. Dr. Martin has been the life-saver for hundreds of physicians.

In closing, so far as our own institutions are concerned, we intend to stand by this program and see that it is put into effect.

THE RELATION OF HOSPITAL STANDARDIZATION TO LABORATORY SERVICE

By JOHN M. BALDY, M.D., Philadelphia

DOCTOR Haywood, who spoke just before Dr. Davis, had a thought which I would combine with what I have to say and with what Dr. Davis has said. And that is the thought of a club over the medical men. I have never liked to admit that to myself but I have not seen it realized in hospital administration. That is exactly what it ought to have. There are enough men who need a little jogging. Can you hold a club over medical men? The whole question of hospital standardization is utterly hopeless if medical men cannot be whipped into shape to see that it is applied in every department.

The second thought is: The trustees lie down on the job, allow their names to be used and abused, and perhaps know nothing about their actual duties.

Now, as bearing on the laboratory and as far as the laboratory is germane to these thoughts, it is just this:

The boards of trustees have no better club, the boards of trustees have no better source of information, as regards the competency of their staff, as regards the earnestness and honesty of their staff, as regards the obedience of their staff to the rules and regulations of the hospital, than is furnished by the laboratory. Do these men in business take things for granted and receive no reports? I do not believe they do. They would not be the successful men they are if they did. And they would not be wanted by the people of the community to head their hospital organization because they are not getting reports of their business. Then why should they not ask to have systematic reports from the heads of this organization? If the board manager will say to the staff, to the superintendent, to the pathologist, etc., that every month he expects to have laid on his table reports of exactly what has been done in each department—so many tests for typhoid, etc.—and if in addition to that the name of the physician is placed opposite the number of the case, it will mean something. You will find that one man in the surgical department has asked for a hundred tests and another has asked for three. The first time that happens—very well, we call attention to the contrast. And the second time, it grows into a serious conference and the surgeon is told that this hospital board expects every man to do his duty; we do not like the looks of this contrast; this laboratory costs money, we have expended money on it; we want his record to show as well as Doctor Smith's—who has a hundred, while he has three; it must be corrected. And the third time: "We are sorry but we want your resignation." And you have to ask only one man on that hospital staff to resign. And if you want to get something out of your laboratory, the young man just out of college looking for a field is the man you can depend on. I would like to call attention to the fact that that is one prime duty of the pathologist, to check up you medical men, and that applies to all the medical staff. If he is a man of the proper caliber, if he is educated to the fact that that is part of his duty, if he is educated to have tact and not to lead his colleagues in the wrong way, they will be glad to have his counsel. He is there not as a technician. He is there as a consultant.

And I say to you boards of trustees by this system you can tell what every man can do. You have it in the laboratory, you have it in the record system. Every hospital should have an historian. I mean an employe, call him what you choose, whose prime duty is taking care of the records and rejecting absolutely every sheet that comes in improperly filled out.

THE STANDARDIZATION PROGRAM OF THE AMERICAN COLLEGE OF SURGEONS

By Rev. CHARLES B. MOULINIER, S.J., Milwaukee
President, Catholic Hospital Association

THIS is the first time I have been put down on the program to present the plan of the American College of Surgeons. And yet I think, during the three and a half or four years that I have been co-operating with the College, I have always been talking on that topic.

You have heard already what are the requirements of the standard. You have heard a great deal about organization of the staff, about the records, about the laboratories, and the division of fees, and about the autopsy work. I shall not go into any technical details because they have been set before you by those who have technical knowledge. I shall try to present to you, in as few words as possible, what seem to me to be the great historic facts of this movement for better hospitals—the scientific fact that underlies it, the ethical basis of it, and its bearing on the religious thought and feeling and spirit which is inevitable.

Historically, the Council on Medical Education began this movement for better hospitals when it began to make the medical schools better and when, following that wonderful movement, it began to look to the interests of the interne some 8 years ago. Some 5 or 6 years ago, the American College of Surgeons, stirred down into the depths of its soul, began to realize that it had a mission for the better care of the sick in the United States and Canada and made up its mind, as you all know and have been told, to improve surgery. But everybody also knows that you cannot improve surgery unless you improve everything that centers in the work of the hospital. And so the American College of Surgeons had not gone very far with its efforts and purpose to improve surgery when it realized that it had to improve everything in medicine.

Knowing that the Council on Medical Education had begun this work, the College, in its fine spirit of honor and regard for the professsion, went and said: "This is what we want to do; what are you going to do?" And the reply was: "Go on and do your work and we will stand by and help you." Therefore, you members of the American College of Surgeons, take it down deep into your hearts that you have been doing a wonderful work for the whole profession in bettering hospital service to the public.

That is the historic fact—absolutely unquestionable because I know it from personal experience in the movement from the very beginning, and hence I always take an occasion like this to say: "All honor to the American College of Surgeons." And furthermore, they are in the middle of the work. It is well begun. They have gone on, let us say, toward the middle of it and they must carry it on to the end, because they are the only body of people as far as I can judge, capable of finishing the movement, at least up to that point where it is sure and safe and sound and destined to go on. That is the historic point of view.

Scientifically, it seems to me that this should be said: The mind of the medical profession is being reached as it was never reached before, to make it more keen, more analytical, more cautious, and more co-operative in its scientific combination of thought, in its analysis of assembled facts, in its careful, gradual, step-by-step arrival at a diagnosis. And this grows out of the organized staff. This grows out of the monthly staff meeting, or weekly departmental meeting, as the case may be. It has brought about that the medical profession working in the hospital has come to the conclusion that minds must get together, that facts must be assembled, and the right analysis of those facts arrived at either by the individual, a small group, or the whole staff. In other words, gentlemen, without intending it, as I observed throughout the continent, the medical mind is being convinced by this program of yours that the time for independent and separate and distinct and hostile personal thinking is past in medicine. Today everybody is convinced that no medical thought is finally safe for the patient, for the public, until several minds have agreed. Standardization, therefore, in as far as it means organization of staff, in as far as it means monthly conferences, has meant a great development of the medical mind throughout the country, and, above all, a great development of medical character. Men today, instead of being distinct individuals, are growing into the greater stature of men working with their fellows, an embodiment of much greater capacity and character communicated into action.

Just one more word about these monthly conferences. I believe there is an incomplete ap-

preciation of what they mean. The College speaks of them as clinical conferences, as investigating the clinical experiences of the hospital. But the College does not say, except impliedly, that in these monthly conferences lies the secret of the success of the whole movement. Your records will not amount in value to the paper they are written on, your laboratories will be useless, you will get no autopsies worth while, the unjust division of fees will go on, unless your monthly conferences are genuinely, are sincerely, are absolutely high-minded and get down into the very heart and soul of every man. Because, gentlemen, what is the monthly conference? It is a review of what was done at the whole institution for every patient that came into the hospital. I do not care how many statistics you have, how correct they are, the facts in figures are without the scientific soul of the facts, unless the soul of the medical man is big enough to analyze those facts. Thirteen deaths in the past month means nothing. Why did each one die? So many unimproved in the hospital means nothing. Why are they unimproved? What has been the use of the laboratory? Why haven't we had more autopsies? Gentlemen, it is hard, it just tears the soul out of a medical man to have to face his own failures, his own incomplete work, his own missing of diagnosis, his own failure to have consultation when he should have had it, his own incapacity to assemble the great facts involved in the case and then miss in his diagnosis or fail in his operation or somewhere in his treatment. They call it a minimum. I call it a fundamental.

And here let me make a plea, such as was made here on the stand this morning, for the young man, for the man that wants to grow. Let the older men play the big brother. Let them be the outstanding leaders, not so much in what they know or in their skill but in their greatness of character, in their readiness to say, "I don't know, I failed, help me."

Now, just one more word on that question of the monthly meeting. The American College of Surgeons has a mission. There is an apostleship for them to take. They have not been brave enough. They have not been aggressive enough. They have not in all cases set the great example of genuineness in these monthly meetings. Those monthly meetings cannot be like the County medical meetings or those of any special association and at the same time attend to the business of the monthly meeting. What has been done for our patients? Where have we failed? Where have we succeeded? Papers, discussions, cases are not the real thing in those meetings. There is no intention on the part of the College to displace County medical meetings, to displace the work of your specialist society, which is all one thing. What has this hospital, from top to bottom, from engineer to superintendent, including the nurses, the orderlies, and everybody—what have we done for our patients during the past week or month?

The College started with the thought of bettering surgery. They are in the midst of bettering the whole practice of medicine. Why? Because the heart of the movement, the heart of the record, the heart of the monthly meeting, the heart of the service in the laboratory—I mean scientific heart and ethical heart—is diagnosis. It all centers on diagnosis; no hurried, no snapshot, yet no elaborate (beyond human frailty) diagnosis, but a genuine, sincere, a definite, direct, cautiously and deliberately arrived at diagnosis of what is the matter with the patient. That is the heart and soul of medicine.

Here again I would like to say a word of commendation, a word of praise, a word of congratulation to the members of the American College of Surgeons throughout the country for the thoughtful, the really scientific, and the deeply conscientious way in which they are going at this program. There is no doubt about it, gentlemen, if I am at all safe in my conclusion on the reading of medical history, that there has never occurred a movement equal to it in the past history of our race. Here we have a great body of men on a great continent—and it is sure to reach the rest of the world—facing a tremendous ethical responsibility by a keen administration that is scientific of the laws of health. It is done because you all, down deep in your hearts—and particularly is it true of the hearts and minds of those men who have led the movement, Dr. Franklin Martin, Dr. John Bowman, and others in the office who have led the movement—feel that it is the greatest in the history of medicine.

If I may be allowed just a few more words: At the first meeting you had in Chicago, when you began this plan, I was fortunate enough to be asked to address you. There were there three hundred members of the American College of Surgeons and the title of the program was "Hospital Standardization." And I can recall with a great deal of vividness that at the end of the morning program I arose and I said: "Gentlemen of the American College of Surgeons, your title may be all right but I am going to be bold enough to say to you that it means not primarily standardization of hospitals but it means the standardization of the medical profession, in mind, in character, and in heart."

REPORT OF RECOMMENDATIONS OF THE AMERICAN RAILWAY ASSOCIATION IN CONNECTION WITH HOSPITAL STANDARDIZATION

By DANIEL Z. DUNOTT, M.D., Baltimore
Chairman, Medical and Surgical Section, American Railway Association

I HAVE been requested to speak to you this morning on what the railroads have been doing in connection with this program of standardization. And in order that you may form some idea and reach some conclusion as to just what we will be able to do to assist in this movement, I think it might be well to spend a minute or two on the question of what the organization is that I am speaking for.

The American Railway Association is an organization made up of the presidents and managers and operating officials of the various railroads throughout the country that are members of this Association. The Association membership comprises about two hundred and eighty-four thousand miles of railroad in the United States and Canada, and you will therefore see that practically every railroad in the country is a member of this Association.

The Association itself is conducted in the following manner: It has its own president and its general secretaries and secretaries of sections. The operating officials of the American Railway Association, the men who pass upon the recommendations made by the various sections of the Railway Association, are the general managers and the president and vice-president of the railroad, and while the action of the American Railway Association itself is not compulsory or mandatory, it becomes a forceful action as a recommendatory practice because the very men who are called upon to accept the recommendation of the American Railway Association are the men who have favored such action.

The American Railway Association has numerous sections. It is needless for me to go into details in regard to them. Our section is the medical and surgical section and this section comprises, or is made up of, the railway and surgical chiefs of these various railroads that are members of the Association. This section was first incorporated in the American Railway Association about a year ago. And one of the first actions of the committee of that section was to take up the question of hospital standardization, because the railroads felt that it was imperative that our employes injured in service must get all possible care and attention.

The committee on hospital standardization discussing this subject made the following recommendation through its chairman, Dr. A. F. Jonas, of the Union Pacific Railroad:

"The medical and surgical section committee on hospital standardization held a meeting at Chicago on April 6, 1921. In accordance with its understanding of its purpose, it has adopted the minimum standard as the basic recommendations for the railroads of the Association."

The recommendation of the committee was accepted and it was submitted to the various members of the sections, who unanimously approved it and on the sixteenth of November it will be submitted to the annual session of the American Railway Association, and I have no doubt in the world will be approved.

Now, this will mean that the railroads through their surgical service will take the position that they will have their men treated in hospitals that meet with the minimum standard of the American College of Surgeons. You appreciate as well as I that a large amount of our work is of an emergency character and that, therefore, we cannot always be choosers. There will be times when we will have to put men in a hospital that has not adopted the minimum standard for hospitals. But it is our intention wherever it is practicable to remove those patients from such hospitals and put them in a hospital having the minimum standard just as soon as consistent with safety to the patient. I do not know but what it is a pretty good thing to follow that up even a little bit closer than that. I am sure that in a number of instances the transportation of a man seriously injured—crushed leg, we will say—for a greater distance to a better hospital would be giving that man a greater opportunity for recovery than putting him in a hospital that was not up to the standard in its work.

GREAT IMPULSE TO STANDARDIZATION MOVEMENT

We have in the railroads about thirteen thousand doctors and students acting in the capacity of surgeons for the railroads. And we have about 275 or 280 men who are members of

surgical staffs. And with the railroads taking this position, I believe that it will be a tremendous factor in assisting the bringing of standardization over a larger field.

I cannot give you the exact or even the approximate number of hospitals that are used by the railroads. I hoped to be able to get that but I could not. I know that the Baltimore and Ohio uses about 310. The Pennsylvania railroad uses about 277 hospitals. The Union Pacific, on the other hand, a railroad of about nine thousand miles, or three thousand four hundred miles larger than the Baltimore and Ohio, uses only about 123. The Union Pacific has 20 hospitals that are under its own control, at least that they contract with. The other hospitals are hospitals that they have used from time to time in emergency.

The railroads use four-fifths of the hospitals of the country, and while of course a large number of the hospitals have already reached the minimum, still there is a very large field which will be affected by this position of ours, and I can assure you the doctors of the American Railway Association are going to take the position not verbally but actively.

THE INDUSTRIAL HOSPITAL

By EDWARD MARTIN, M.D., Philadelphia
Commissioner of Health, State of Pennsylvania

SHORTLY after our last election in Pennsylvania, in talking with the attorney-general, I said: "The woman's vote has not been conspicuous for its power." And his reply was, "Doctor, there ain't no such animal as the woman's vote." And so in regard to the industrial hospital.

With some exceptions in some localities and in some businesses, I think, and my belief is, that there "ain't", or should not be, such an animal as an industrial hospital. The problems of industry are the problems of civil life.

We see much of special courses in industrial surgery. The basis of industrial surgery is the fundamental medical education, a long training under the eye of an expert, and that training that fits men for surgery in general.

Each industry has its particular form of accidents and each industry must have special experience in that line, and a school of industrial surgery cannot be established in Louisiana, Pennsylvania, or even in Massachusetts, but must be based on that sound, fundamental, surgical knowledge acquired by elbowing or being with a master of his craft and then further knowledge in the individual industry concerned.

And the same holds true, since we are speaking of hospitals, on the medical side.

The answer to industrial surgery would seem to be comparatively simple. There are some people who are obsessed, who are possessed, who are enthusiastic, who are—we will say—crazy, in certain directions. They are the people who lead the progress of the world. Who of you, going back to your school days, going back to your graduating period, who of you would accept any full-time position with no opportunity of rising beyond the high-school course? Who of you would want to lose his ambition and serve an industry on a given annual sum for which they assume the entire responsibility in their hospitals and care for the people of that industry? That is a check strap to all future progress. So that seems to be the simple answer, "There ain't no such animal as an industrial hospital." There "ain't no such animal" as an industrial surgeon. It belongs to the best of the profession to guide and train those who are coming on.

THE INDUSTRIAL DISPENSARY

By F. L. RECTOR, M.D., New York
Secretary, Conference Board of Physicians in Industry

THE industrial dispensary need not have the equipment or personnel of a hospital unless it is remotely situated. The average industrial plant is in or near a community with hospital facilities. The care of minor injuries is all that should be attempted in the routine work of such a dispensary, major work being sent to the larger and better equipped general hospital. In those cases where the industry is remotely situated it will be necessary to provide more ample hospital facilities; but in these cases the general hospital becomes more of a community institution for the workers and their families in cases of injury or severe illness, while the smaller

and more convenient dispensaries for treatment of minor cases are placed in the plant itself.

Dr. Clark of the Norton Company believes, and others agree, that it is necessary from the standpoint of economy and production that no employee should be ordinarily over 15 minutes from a dressing station. In a scattered organization this need can be met by having branch dispensaries in charge of nurses placed at strategic points throughout the work for the first care of injured workers, the physician being on call at the main dispensary and in addition having regular office hours at each branch dispensary. By this means a maximum service can be supplied to workers.

Just a word about records in the industrial dispensary. A fairly representative experience in the inspection of industrial dispensaries has shown that those who keep adequate and intelligent records are in the minority. I have found record forms varying from a blank 3 by 5 library card to a form 10 by 12 inches in size, both sides of which were filled with information about the worker. Many industrial dispensaries religiously collect records and just as religiously file them away without any attempt at analysis.

The proper use of such records can be of great assistance to the production department, as many times the information that they contain will bring to light causes of retarded production that would otherwise escape recognition. Such records often indicate the health standing of the home and community and will enable the plant physican to be of material assistance to the work of the public health authorities.

The physical examination of industrial workers is made of greater value by a proper record system. One important point is frequently overlooked in this work. Some physicians insist upon a very detailed record of the examination of every person, thereby consuming valuable time without an adequate return to the employer or employee. In this connection this fact should be kept in mind: there is a big difference in the physical examination of the industrial worker and the hospital patient. In the case of the worker we are dealing with an individual who is well or thinks he is well, and who is being examined for a specific purpose, namely, his ability to perform certain kinds of work. Only those conditions which have a bearing upon his employment are of immediate interest to the examiner. In the other case the hospital patient is sick or thinks he is sick and the examiner is justified in going to extreme lengths if necessary in order to find out the true condition of the patient.

The earnest effort of most of the physicians in industry to utilize the services of all who apply, even though some may be defective, is doing much to break down the opposition to physical examinations that has existed on the part of some workers and particularly the labor organizations. The Conference Board of Physicians in Industry has formulated the principle that, provided there are positions to be filled, employment should be denied no one unless, when employed, he becomes a danger to himself, to others, or to property.

As to staff organization in the industrial dispensary, I found in a recent survey of over 200 plants, that in 101 establishments with one or more full-time physicians, there was an average of one physician to each 3,083 workers. Please keep in mind that the figures just quoted are *averages* only. In any given case the staff organization required will depend not so much upon the number of employees to be served as it will upon the character of the industry and the different functions delegated to the medical department.

Another important consideration of the work of the physician in industry, and of the value of the industrial dispensary to the workers, is that of the administrative responsibility of the head of the medical department. In visiting nearly 100 industrial plants in New England last year it was found that in only 39 was the medical department under the direct supervision of an executive of the rank of works manager or above; while in 44 other plants the responsibility was to the employment manager, industrial relations superintendent, or other subordinate official.

In the survey of 207 plants just referred to, which covered more generally the larger industrial sections of the country, the same conditions were found to exist. In 108 plants the works manager or a higher executive supervised the medical work, while in 95 plants this work was under the person in charge of industrial relations, safety, employment or compensation, office manager, or other subordinate. Obviously the work of a department of the importance of the dispensary should be accorded the standing of other major divisions of an industrial establishment.

Discussion on Industrial Hospitals and Dispensaries

John B. Lowman, Johstown, Pennsylvania: It has been my privilege to be connected with, I think, perhaps the best industrial hospital that was ever built in the United States, forty years ago. At that time, as you know, the corporations did not realize what benefit they would derive from taking care of their own sick and wounded. Through my father, the Cambria Steel Company was induced to build a small hospital for the care of the sick and wounded. They appropriated the sum of ten thousand dollars for this hospital and founded ten beds. It was very hard at first to get any patients into this hospital establishment. But finally, after a certain length of time, the usefulness of it was discovered by the corporation and that hospital has been increased from that time on, until last year they built a new hospital costing about eight hundred thousand dollars. That simply meant the advisability of taking care of the sick and wounded not only from the humanitarian standpoint but also from the financial standpoint.

William O'Neill Sherman, M.D., Chief Surgeon, Carnegie Steel Company, Pittsburgh: During the war, fifty thousand two hundred and eighty soldiers were killed. During that same period, there were one hundred and twenty-five thousand accidental deaths in this country. Thirty-five thousand were killed in industries. Seventy-one thousand were killed outside of industries. Of this number twenty-five thousand children under the age of twelve were killed. There were two million injured, the disability lasting one month or more. And basing our statistics on the monthly disabilities, I would say there are twelve or fifteen million minor injuries of a disability of less than one month. In Pennsylvania in 5 years there were fourteen thousand two hundred and forty-two fatalities, three hundred and twenty-seven thousand serious and six hundred and fifty-three thousand minor injuries, making a total of approximately one million accidents in the State of Pennsylvania within 5 years, or seven hundred each working day. There were fifty-one thousand accidental and violent deaths in Allegheny County between the years of 1903 and 1920, inclusive. The compensation costs in this State, for the killed and injured in these 4 years, amounted to forty-eight and a quarter million dollars. The statistics of the New York Compensation Commission show that 33 per cent of the cases coming up for compensation adjustment require further reconstructive surgery. In other words, the general surgeon's or the general practitioner's work has to be reviewed and referred to an orthopedist or some one else who is doing his reconstructive work. That is an indictment of the character of work that has been done by the general practitioner. A speaker of the State Compensation Commission some few years ago referred to the fact that in approximately 35 per cent of the cases of application for compensation there was evidence of infection. That is another indictment against our general surgeons and general practitioners.

While some are still crying: "Why standardize every hospital"? we would say, "The American College of Surgeons should standardize the equipment and should standardize the methods of treatment."

Some of our failures have been due to neglect in therapeutics. We have absolutely neglected electro-, mechano-physical, and hydro-therapeutics. I have it from very good authority, a gentleman who has visited every hospital in the country, that there are very few of the hospitals which are equipped along these lines. And as the result, we are driving the people into osteopathy and to the chiropractor. We are responsible for it.

The American College of Surgeons should standardize industrial hospitals

There is no question, gentlemen, that the American College of Surgeons is the institution through which a higher and more scientific work can and should be introduced into the industries of this country, and that embraces necessarily the railroads and all of the great industries of our land.

I do not mean that they should have a policy of "You must do so and so," but a policy of this kind, that "Upon investigation, we believe that this or that method has brought about the best results." And in this way the industries having hospitals would whenever possible introduce standard methods.

General Discussion

Mr. Daniel D. Test, Superintendent Pennsylvania Hospital, Philadelphia: I want to congratulate the College of Surgeons on its program of standardization, and the splendid progress it has made. Hospital standardization means the standardizing of the personnel as well as hospital equipment and practice. This means managers, doctors, and executives, and all must have a share in the work. Until we seek to standardize ourselves, our efforts to standardize our hospitals will be feeble.

So long as managers fail to recognize that sound hospital management rests upon fundamental principles which have been established by experience; so long as doctors insist on policies that their colleagues do not want or approve; so long as superintendents try to make rules for everything, and then think that their rules are as sacred as the laws of the Medes and Persians, just so long will hospital standardization be impossible and hospital work be inefficient.

The old idea of each group being suspicious of, and antagonistic to, the others must give way to a co-operative partnership which will co-ordinate all the efforts which the hospital makes. If this result is attained, the doctors and superintendents through their organizations must talk and work for sane standardization, and we must seek to impress upon managers the necessity for their joining heartily in the work, with a view to standardizing themselves as well as their subordinates—the doctors and the superintendents.

The progress which the College has made since its meeting in Chicago 4 years ago should give us fresh inspiration for further effort. Two days were given to standardization at that time. When I think of the first day and a half of that meeting I am reminded of how I was impressed with the great need for standardization among the physicians present. During this time one doctor after another spoke of the importance of standardization, but before closing his remarks every one said in effect that nothing must prevent the doctor from having everything he wants and just when he wants it. I was wondering how standardization was going to have a chance when on the afternoon of the second day a doctor began his remarks by saying: "It is about time we were turning from the consideration of what we want, to the consideration of what we ought to have, with due regard for the other departments of the hospital." This entirely changed the key-note of the meeting, and seems to have set a standard for us all.

I do not speak of this in a critical spirit; but merely to show the progress that has been made. The attitude at the time was perfectly natural. None of us had thought the matter through. We were still living under the old dispensation of hospital work. The new dispensation of co-operation has dawned, and the College of Surgeons has sounded the first call.

Mr. John Smith, Superintendent, Hahnemann Hospital, Philadelphia: In the 3 or 4 years that the American College of Surgeons' standard of diagnosis and records has been in progress, we can see a wonderful improvement in the treatment that the patient gets, the treatment he gets immediately after admission, the preliminary history, and the laboratory privileges, and throughout this whole program we have become more careful, and the patients themselves have received a wonderful benefit from it.

George O'Hanlon, M.D., Superintendent, Bellevue and Allied Hospitals, New York: The program has been most interesting and most helpful, not only to those that have already met the standard during the past 3 or 4 years but to those who are still "without the faith." I am very sure that after this meeting the trustees, the attending staff, and everybody connected with the hospital will make it their individual and combined effort to meet the requirements. They are so simple although in some cases expensive. They can without any difficulty be met.

I happen to be connected with five hospitals, all of them teaching institutions, with one exception. When the standardization of hospitals was introduced, we met the requirements. They are City institutions, maintained at the expense of the City of New York.

In passing, I might just tell you—those who are unacquainted with hospital organization in New York—that the general hospitals of Manhattan are under a board of trustees. The public hospitals of Brooklyn, Staten Island, and Blackwells Island are under the commissioner of public welfare. The commissioner of public welfare took the lead, 2 or 3 years ago, and issued a general order applying to each and every hospital of the Department, directing the staffs to comply with the minimum standard.

For several years it has been our practice to have not only the regular staff meetings and attendant staff meeting, but the administrative staff meet at least once each week; the superintendents, assistant superintendents, superintendents of nurses, purchasing agents, doc-

tors, and all the people who were recognized as heads of departments are called together each Saturday morning. The general affairs of the institution or of the department are taken up and discussed, so that each person knows the difficulties that we have to contend with, whether it is difficulties with the attending staff, difficulties in the operating room, difficulties in getting money from the City Fathers, changes in the personnel, changes in the pay-roll, and even the question of infection in the wards. The superintendents and pathologists of each of our hospitals attend all meetings of the board and present a report of the work that has been done at each hospital and the sources from which these reports come, so that it is apparent who makes use of the laboratory and who does not, and the amount of increased interest and care shown. A few weeks ago at one of the hospitals complaint was made that the laboratory service was not satisfactory and the pathologist was not present to report. So the next meeting we asked him to attend and give in detail the amount of work he was doing and the sources from which those requests came. During the preceding month, the hospital, with perhaps four hundred admissions, and a very active service, made requests for two blood counts. I think six autopsies had been performed. They asked why he did not do more. He said no one asked for more; that he had on one or two occasions gone into the wards to learn something about the cases, and it was made very apparent to him that he was not welcome; so that he had profited by that experience and lost his interest. And as the result of that conference, the staff are making much more use of the laboratory.

GENERAL SUMMARY OF HOSPITAL STANDARDIZATION AS INAUGURATED BY THE AMERICAN COLLEGE OF SURGEONS

By MALCOLM T. MacEACHERN, M.D., C.M., Vancouver
Superintendent, Vancouver General Hospital

SUMMARIZING hospital standardization, as inaugurated by the American College of Surgeons: You have come here with set opinions, you have gained new opinions, your old opinions have been intensified by this wonderful meeting today. But how are we to think of this hospital standardization meeting? What is your psychological reaction? You have been impressed with the fact that this movement pleases all.

Now, one or two thoughts: First of all, because of the better working out of the cases in the hospital, because of better diagnoses, because of more intelligently applied treatment, because of the staff review conference work, what are your hospitals showing statistically? If we were prepared to present complete statistics today, they would absolutely run like this: lower death rate; reduced number of operations; fewer postoperative infections and complications; and lastly a lessened patient's days' stay in the hospital. We have some statistics already showing this conclusively, which may be mentioned at the round table this afternoon.

The second thought: This movement has created a deep sense of responsibility in our so-called hospital groups in the care of the sick, whether in the hospital or outside. First of all, the administrative side of the hospital has been affected as you have been told today. The staff of the hospital has become more conscientious to its duty. Second, the medical men have been impressed by the movement and are trying to mold their ways to produce better and more scientific results. Thirdly, the boards of trustees are realizing their responsibility. They are realizing, indeed, that they must have two reports: first, a financial report; and second, this report, what I could call the physical report of the hospital, showing the physical assets and liabilities. And the assets are: patients discharged well and improved. The liabilities are: deaths, unimproved cases, infections, and complications. And from these they make their balance sheet.

The next thought: what are the people thinking about this? Before they go in for treatment the people are now asking what hospitals are meeting this required standard.

This program that you have heard today surely has impressed you with the fact that it has carried a message of better service in the hospitals of both countries and hundreds and hundreds of thousands of patients, now and later, must surely benefit by it.

Lastly, how does it affect the nation? It is one of our great economic questions, because it means that by hospital standardization there are fewer deaths, there is less cost to the hospital in the care of the patient from fewer complications and infections, and finally there is a shortened days' stay in the hospital, which means, as the industrial representatives have told you, putting the patient back to producing capacity sooner.

AFTERNOON SESSION—ROUND TABLE CONFERENCE

HOW HOSPITAL STANDARDIZATION CAN IMPROVE THE PROFESSIONAL WORK AND THE SERVICE TO THE PATIENT IN THE HOSPITAL

CONDUCTED BY MALCOLM T. MACEACHERN, M.D., C.M., VANCOUVER
Superintendent, Vancouver General Hospital

DR. M. T. MACEACHERN: Before starting the Round Table, I want to mention seven points which I think are stimulating at this time in order that we may give better service in the hospital to the patient, and it may in a way summarize the work.

First, giving to the patient upon admission a good reception so as to put the patient in a comfortable mental attitude toward the hospital and the staff, so that the patient will react more favorably to treatment.

Second, prompt attention at all times to the patients' needs, whether large or small.

Third, competent examination of the patient, with a carefull record of the same; a careful record of everything concerning the patient while in the hospital.

Fourth, availability and utilization of all the diagnostic and therapeutic facilities necessary in making a good diagnosis and carrying out effectually applied treatment. Get the two points—first, all the facilities for a good diagnosis, and second, all of the facilities for effectually applied treatment.

Fifth, consultations between your staff; consultations between the staff and the administration; consultations both scientific and administrative.

Sixth, careful analysis of the work that you heard so splendidly put to you this morning in the staff conference, and, Seventh, intelligent monthly reports to the board of trustees.

Now, this means better diagnosis of your patient, better application of the treatment, and return of the patient to producing capacity as quickly as possible in the most efficient and most comfortable manner. That is what your patient expects of you as hospital administrators and as surgeons and physicians. That is what the public, as the financial support of your hospital, expects. Just as in a factory, putting out a certain product, so our product here is health, which must be of the highest standard. Now, these services which concern us chiefly today are scientific services of the hospital, for which we can set no limit.

SECTION A—STAFF ORGANIZATION

1. *Many hospitals find difficulty in formulating staff by-laws, rules, and regulations for the guidance of the professional work therein. How can the College give them greater assistance? Can they secure a set of standard by-laws, rules, and regulations setting forth the principles involved which shall guide them in drafting their own?*

DR. FREDERICK W. SLOBE, Chicago: There have been many changes in the general policy and system of the staff rules and regulations during the past 5 years. Originally, the constitution of hospitals embodied general principles of organization chiefly, and contained practically no details relative to the clinical management of the hospital. During the last 5 years, however, as a result of the great emphasis placed upon staff meetings and staff organization, case records, and laboratory facilities, in the standardization campaign, there has been great emphasis placed upon certain rules which would carry into effect the principles of the minimum standard.

Of course, there is no one standard set of staff rules and regulations which can be applied to all hospitals. Naturally, a hospital of fifty beds in a small community cannot use the same constitution and by-laws which would be applicable to a large hospital in a metropolitan center. Therefore, the College advises certain broad principles only, leaving the detailed application of these principles to the various individual hospitals themselves. There are certain general rules, however, which have been incorporated in practically all of the rules and regulations. Many of these are so elementary that they may seem entirely unnecessary to some of you who have been associated with larger hospitals in the larger centers. I can assure you, however, that these same rules are almost revolutionary in a great many hospitals scattered over the country. I will mention just a few of these rules which have been adopted and incorporated into the by-laws of various hospitals.

1. That the staff conference include a careful analysis of the results obtained in the hospital during each preceding month.
2. That regular attendance at staff meetings be insisted upon, attendance being expected of all physicians who have had patients in the hospital during the preceding month.
3. That the physicians afforded the privileges of the hospital abide by its regulations and that the practice of fee-division be absolutely prohibited.
4. That the case records be written within 36 hours after admission.
5. That a history, physical examination record, and pre-operative diagnosis be recorded before operation (except in emergencies).
6. That no case record be filed until it is complete.
7. That every specimen removed at operation be sent to the pathological laboratory for a report.
8. That a system of laboratory charges be worked out which will allow every patient to receive adequate laboratory service.

These rules are general and neither impede the initiative of any of the staff members nor hamper individual judgment. The announcement of a definite policy of this kind by a hospital is an expression of its endeavor to live up to its responsibility to the community.

At the College headquarters we have various samples of staff rules and regulations adopted by hospitals in their endeavor to meet the standard. We will gladly send out these samples to any one interested.

2. *Many hospitals require the attending doctors to sign a pledge or card, the latter often being known as the "Physicians' Registration Card." Has this been found beneficial? What is the best form to use?*

Dr. Frederick W. Slobe, Chicago: In order that the physicians may clearly understand a hospital's policy, it has become quite customary for hospitals to obtain the physicians' signatures to the constitution and by-laws. In other instances individual declarations are drawn up, stipulating an agreement to abide by the rules and regulations of the hospital and a pledge against the practice of fee-division. In still other instances, an individual fee-splitting pledge is the only form used. Cards are sometimes used to serve the same purpose.

This procedure on the part of the hospital should not be viewed as derogatory to its staff members. Instead, it is a means of demonstrating to the community the hospital's endeavor to uphold a high standard of medical ethics and practice.

The College has some of the forms which are used by the various hospitals in this connection and will gladly send them to any one on request.

Dr. E. R. Secord, Brantford, Ontario: Just to provoke a little discussion, I will say that we have no cards, no pledges, and as far as I am personally concerned, I am of the belief that he who desires to split fees or otherwise act in a way contrary to the standards that we believe to be proper will not be bound in any way by any mere signature attached to constitution and by-laws, cards, pledges or anything else of the kind.

A Member: The signature to the by-laws and rules and regulations, as mentioned by Dr. Slobe, will have a moral effect on the professional bodies of the hospital.

3. *In certain instances the attending doctors of hospitals have been found lacking in clinical interest. What can be done to stimulate more interest in such cases?*

Dr. H. J. Moss, Brooklyn: The question that we are discussing now seems almost unnecessary. After reviewing the work of standardization of the American College of Surgeons this morning, whereby each surgeon is expected to do the right thing by the patient in the matter of keeping records, it seems to me that this answer takes care of itself.

In the first place, your staff should be appointed only for the period of a year and at the end of the year re-appointments should be made upon the work that each and every member of the staff did during the year. If a record or inventory is kept during each month of the year, it becomes a very easy matter at the end of the year to take a gross inventory of the twelve months and find out what the particular surgeon has done during that given year. You have then, at the end of the year, your whole record of the total of infections, the number of deaths, of that particular surgeon.

In other words you have an absolute inventory of everything that the man has done during the year. Then if he has fallen short of the requirements, that particular man should not be re-appointed.

If you adopt that rule, I think you will not have to be concerned about the interest that each individual doctor shall take in his individual work.

A Member: I have found in hospitals the best clinical stimulus is the staff conference. In the

modern hospital the material that is discussed at staff meetings is a great stimulus.

4. *How often should the staff conference be held and what is the best form for it to take, a luncheon, a dinner or an evening meeting? What should constitute the agenda for such a meeting?*

DR. FRANK J. JENNINGS, Brooklyn: As to the frequency of staff conferences, we feel that that is largely a local matter. Hospitals and staffs vary. In the average general hospital which has on its staff a good many general practitioners, we feel that a meeting held once a month is to be preferred, and that it should be a convenient meeting, the later in the evening the better, subject to certain limitations. I do not mean to hold it at midnight, but at 9 or 9:30, so that the man in general practice who has evening office hours has a chance to take care of his office or to make a call or two if he has to make it, and get to the staff conference.

In a small, closely controlled staff, the weekly meeting is a splendid meeting; as, for example, at the Woman's Hospital at New York under the direction of Dr. George Gray Ward. When a hospital is starting staff conferences and perhaps has friction or factional feeling to eradicate, a lunch or dinner may be the means of expediting or facilitating the starting of the conference.

Now, as to the "agenda." For the successful formation of the staff conference, you must have a ritual if you are going to succeed. Doctors do not vary much in temperament or character all over the country, and they have not quite reached the point of beginning a staff conference. So the first thing that we believe is practicable is to form a staff conference committee. This is composed of three members, representing the different services in the hospital. It is very essential to have as chairman of that committee a level-headed man who is a good presiding officer.

In the development of conferences, the first thing that is a matter of attack is the record. You have heard described this morning and also this afternoon by Dr. Slobe what a good record should contain. There is no necessity for my going into that, but you will find that through staff conferences your records will steadily improve. At our last staff conference held at St. Catherine's, I think the strongest impression any one would take away was the high quality and excellence of our records.

Mortality we believe is properly a subject for review. The records of those who have died are looked over and those which may point a lesson in any way are selected. The man who is responsible for the case, abstracts the record and reports it. Now, that has a didactic value which to me is beyond criticism. At the last conference a death from incision and drainage of an abscess of the thigh, secondary to osteomyelitis of the femur, was reported. Just to show you the value of that particular report: the patient had taken a general anæsthetic and had gone through a forty-minute operation when her actual surgical capacity should have reminded the surgeon to keep her in bed and to make a small incision only. The lesson conveyed to them was that they should be on the lookout to see that they did not go beyond the limit of the patient's surgical endurance. And you can multiply that *ad infinitum* with consequent good, first of all to your staff, and, of course, always to the patient.

Morbidity, we believe, is a profitable and proper subject for review. Reviews and analyses offer a field that is limitless.

In closing, I may say that the staff conference committee has no rose-strewn path to walk on. They are the subject of criticism almost always, allegations being made that certain men are being favored or that certain men through the conference committee are excluded from conference for one reason or other. We have difficulties with the coterie which says that the whole thing is illegal; so that what we have accomplished in holding staff conferences has been done at the expenditure of a good deal of energy and by overcoming a great deal of criticism.

A MEMBER: A large number of hospitals review three things: the deaths, the unimproved cases, the infections, and the complications, each month.

DR. R. L. DICKINSON, New York: I would like to speak of the Woman's Hospital. Dr. Ward runs one of the best staff conferences I have seen. He begins with a brief presentation by the pathologist of interesting cases. Then he takes up the casualties, man by man. Each man at the head of a service is asked to report for his service, any deaths, any infections, any complications, and any errors in diagnosis. Then the follow-up is taken up, not each week, but once a month. Some interesting cases are taken up and the thing is a very live, keen, active meeting covering one hour.

Another of our excellent reviews is on a different basis. I refer now to Dr. Eugene Pool's conference in the New York hospital. It takes one hour, Friday, at 12, his whole staff being present. His conference is a little review of the staff itself. They have their pathology at a

separate time. They go over their X-ray work after lunch. They take up the errors of diagnosis, the follow-up work, and a general review once a month. They break up the meetings and that is very much better than running 3 hours on one afternoon or evening when everybody is tired out.

The great problem, I take it, is with hospitals open to many men. I recall one instance in a certain hospital—a doctor did not appear at a meeting, following the death of one of his patients. Before the following meeting he was notified, with a statement signed by the superintendent, that if he did not care enough for the service to obey the rules and come and report his casualty, his resignation would be welcomed.

5. *What is the best way to stimulate more consultations between members of the staff in hospitals?*

Dr. John Smith, Philadelphia: Based on nearly 3 years experience with staff conferences, I would say that the answer to this question, how to stimulate more consultations between members of the staff in hospitals, is the clinical conference. What is needed is a feeling of kindliness and co-operation between the various members of the staff and various groups of specialists and there is only one way of doing that and that is through the clinical staff conference. I mean the general conferences as well as the group conference. The group conferences are important, but in order to get consultation you have to get a feeling of good-will and friendliness between the various groups, and a general staff conference is the only way to accomplish it.

In one hospital with which I was connected, up to 15 months before we started the staff conferences, consultations were really rare. We started the staff conferences and before long the men commenced to ask other men to come in and see their cases, and soon we had splendid statistics on consultations, and I believe that is really the only way that it can be done.

SECTION B—MEDICAL RECORDS

1. *Should not every medical man be responsible for seeing that a complete history is provided for each one of his cases, whether public or private?*

Dr. M. T. MacEachern: I think the spirit of the question means that the physician either writes the record himself or sees that somebody writes it, and that it is of good quality and complete. First of all, let us have a show of hands. How many of you think that a doctor should be responsible for a complete history in the light that I have explained? (Vote taken—large majority in affirmative.)

Dr. S. G. Davidson, Superintendent, Rockford Hospital, Rockford, Illinois: On this subject of records in the hospital, should the doctor be responsible for the records? Of what value is the record to anyone except the doctor, primarily? So why should he not be responsible for it? Every man knows that the value of the record to him and his patient lies in the fact that he can go back to those records 1, 2, and 5 years, and study his cases and give his patients better service next year, and better service this year than last. If they are not responsible, who is?

Mr. C. A. Lindblad, Superintendent, Buffalo Homeopathic Hospital, Buffalo, New York: I just want to give you a little experience on this subject. Our institution is an open hospital, but only reputable physicians, physicians approved by a committee, are given hospital privileges. I think that the great difficulty is that the average hospital superintendent is more or less afraid to ask the physicians to do a little work. Three months ago, shortly after I assumed charge of this institution, I wrote a personal letter to each man doing work in our hospital—and by the way, there are some seventy-five or eighty taking care of the private work—and asked each of the men sending a patient to the hospital to write his own histories or see that they were written. As soon as the patient is admitted to the hospital, the hospital statistician in charge of the record room prepares the history blank and mails it to the physician. This letter simply states that we would like to have him complete this preliminary personal history and the working diagnosis and return it promptly in the enclosed stamped envelope. This history can be prepared from his personal knowledge, by his office or clinical assistant, nurse in his office, or he can do it himself. This attempt was simply a try-out to see how it would work, and since we started this three months ago, we are getting 95 per cent of those histories returned to us in fairly good condition.

2. *What is the best way to secure operating-room records and what should they consist of mainly?*

Dr. Simon Tannenbaum, Superintendent, Jewish Hospital, Philadelphia: This question naturally resolves itself into two headings, namely the records that are necessary or essential, and the method of obtaining those records.

If I were asked to say briefly what those records should consist of, I would say that the record should consist of everything relating to the

patient from the time he is taken from his bed for the operation to the time he is returned to his bed from the operation.

These records consist of three parts: first, what is known as the record of the operating room; second, the record of the anæsthesia; and third, the record of the operation.

Now, first, the record of the operating room is a big book which is usually kept in the operating room and consists of brief entries of the patient's name; his location in the hospital; the operation; the name of the surgeon, the name of the assistant and interne and also the name of the anæsthetist.

The record of the anæsthesia should consist of the record taken immediately beginning with the time the patient is removed from his bed, and should contain, first of all, the record of the pre-anæsthetic period—the pulse, respiration, temperature, blood pressure, and, as well, his general condition and the condition of his heart and lungs. Next, the stage of the anæsthesia; the kind of anæsthetic used; quantity used; the condition of the patient during the anæsthesia, giving fifteen-minute record of the pulse and respiration; then the conclusion of the anæsthesia, stating what the condition of the patient is, including his pulse, respiration, and temperature.

The next is the record of the operation itself. Now, it may be a record on a sheet by itself or it may be apart of the general history. That is a matter of choice. The record should contain the pre-operative diagnosis. That is one of the most important parts, perhaps the most important part, of the record. It should then contain a description of the operation, describing step by step, giving the source of pathology, the organs explored, stating whether they were normal or abnormal; the closure, what ligatures were used, and so on; and a most important record, not to be forgotten, is whether drainage is left in the patient.

Now, we come to the method of reporting the operation. That is a matter of choice. Some operators can dictate the operation during the operation itself. Some of our very best surgeons do. Others leave it until the operation is over. It should, however, be dictated immediately after operation, giving in detail, as I said before, every stage of the operation. It is dictated sometimes to the anæsthetist. It may be dictated to a stenographer who is there for that purpose. It may be dictated into a dictaphone, which does not require anybody's time and can be taken off at any time.

The question whether the report of the operation should be dictated by the surgeon himself or whether it should be dictated by the interne is one which is still open. The educational value of having the interne dictate the operation is apparent. If the interne dictates it and it is then read by the surgeon, the interne will certainly be benefited a great deal by it.

Accurate records will very strongly show the character of the surgical work performed in any hospital. It will stare the surgeon right in the face and will show him how often he has been mistaken in his diagnosis and how often he has been right. And that is the kind of record I believe should be found in every hospital.

Dr. M. T. MacEachern: I think Mr. Tannenbaum has covered the subject very fully. On the method of reporting the operation, he gives us, first, the stenographer; next, the dictaphone; and last, the surgeon writing it. The most satisfactory seems to be dictation to a good stenographer.

3. *What is the best procedure to keep accurate records of all postoperative infections?*

Mr. James U. Norris, Superintendent, Woman's Hospital, New York: At the Woman's Hospital, we have a record form of a distinctive color and on it is recorded every dressing from the time of operation, name of Doctor removing drain, number of sutures, wound healing, the promptness of union, condition of wound on discharge, list of dressings, and character of dressing. That is part of every history.

4. *Who should be responsible for overseeing of the medical records as to completeness and quality?*

Dr. F. L. Adair, Chief of Staff, Swedish Hospital, Minneapolis, Minnesota: A question of responsibility is involved in the answer to this question. And it seems to me that we should recognize responsibility of two kinds: First, the collective responsibility of the hospital to the community as a whole. This involves the medical personnel, the nursing personnel, and every individual engaged in carrying out the proper functions of a hospital. The individual responsibility of the physician to the patient cannot be taken over by the hospital, nor can the collective responsibility of the institution be taken over by the physician. It may be assumed largely that both the institution and the physician are responsible for the completeness and quality of these records. The keeping and preserving the records is easily the function of the administrator of the hospital, and can quite readily be taken care of by somebody. It is merely checking of the different sheets, to see that they are present in the record before the record is filed away. Administration is also re-

sponsible for the enforcement of this, because it is responsible to the public for the maintenance of these records as one of its functions and obligations to the community.

The accuracy of the records cannot possibly be checked by the administrator nor by the historian, or record clerk, whatever she may be called. That must be up to the individual medical men. No one else can be responsible for the accuracy of the records. And it is better probably not to have any records than to have inaccurate records. Of course, a certain amount of inaccuracies will creep in, but on the whole, if records cannot be depended upon for accuracy, they are worse than useless.

The attending man or the visiting man who is responsible for the care of the individual patient must either supply the record from direct contact and direct history and examination of the patient or he must do it by proxy through a member of the house staff. Either one of these might work out differently in different institutions. In the last analysis, the enforcement of the accuracy of the record is not up to the hospital administrator but to the staff, because medical men are the only ones competent to pass upon the fundamental accuracy of these records. This is done, as has been pointed out, through these monthly conferences, where the records are subjected to the scrutiny of medical men.

There is another point and that is the duplication of records where the physician keeps in his office complete records of the case, as any up-to-date medical man should, and when the patient goes to the hospital, a record of the case should remain in the hospital. This involves a certain duplication of effort and the cost of it comes back on the physician or the community, as the case may be. It seems to me that the logical ultimate solution of this question is through a closer association of physicians with hospitals, so that the institution and the physician's office ultimately become consolidated, so that, instead of duplicating records there is finally only one record and the work of the medical man becomes identified with the institution. It seems to me that that is at least one logical conclusion of this problem.

Dr. W. A. Hausman, Jr., Allentown, Pennsylvania: I think it would be easier to bring about the writing of records if a rule were made that all cases must have their records complete before the patient can be operated upon. The provisional diagnosis must be made at the time of the examination of the patient and those records must be completed before the patient is operated upon.

As to the question which is up at the present time, at the Sacred Heart Hospital we have made it a custom for the chiefs of the departments to O.K. records at the completion of the case and each one of the records is gone over to see whether the record is there in its entirety. We pay no attention to small errors or differences in diagnosis or things of that kind at the time, the aim being to see whether that record is complete or not. The chief of the department goes over the same and passes it if it is correctly filled out. If not, it is passed back and is not filed and is placed among the incomplete records until such time as it is corrected by the surgeon in charge.

Dr. G. E. Follansbee, Cleveland, Ohio: I cannot agree with what the speaker has said about the responsibility for the record. Theoretically he is right but practically I believe he is wrong. A man's conscience in a great majority of cases in the hospital staff is not a sufficient club to make him give you a complete, accurate, and truthful record. He may make his record complete, but I will question a great many of the records in a hospital as to their truthfulness unless those records are carefully gone over and minutely inspected with a suspicious eye by a competent record keeper or a man familiar with records.

This matter has come to my attention before and I have been somewhat interested in looking over the records in hospitals to see how well those records were kept, and I am sorry to say that in some hospitals, with apparently satisfactory records, careful investigation revealed very untruthful records. I believe that the responsibility of a correct record belongs in the hospital and that there should be some one in the hospital, preferably connected with the staff and interested in the matter of records, a sub-officer of records, whose duty it shall be to go over those records with a fine-toothed comb. If we do that and then untruthful or unsatisfactory records are brought up, we can get records that are of some value. But of what value, I would like to ask you, is an untruthful record in any hospital. You are better off without a record than to have an untruthful record.

Dr. Edward A. Weiss, Pittsburgh, Pennsylvania: We have found that the most satisfactory method of proving the record as to correctness and completeness is to have a committee of three from the staff. Each man takes 2 hours a week and goes over the records in the record room and approves them if correct and then they are filed. If incorrect or deficient in any respect, a note is made on that record and the individual member of the staff to whom the case belongs is

then called to the record room and required to complete it. If a blood count, for example, has not been made, he is required to write on that record why this was omitted, etc. This committee serves for 3 months only and then three other members of the staff are appointed. No member of the committee is permitted to pass on one of his own records. This has worked very satisfactorily with us.

Dr. E. A. Sommer, Portland, Oregon: I believe that the hospital ought to furnish a stenographer to take the record of the operation and place it on the history and then allow the surgeon to O.K. it.

SECTION C—LABORATORIES

1. *What laboratory work should a hospital of 75 to 100 beds provide as a minimum service?*

Dr. M. T. MacEachern: To expedite matters I have distributed a little pamphlet covering this subject (sent on request).

2. *A hospital wants a routine pathological service in connection with their surgery. How can such a service be financed?*

Dr. S. G. Davidson, Superintendent, Rockford Hospital, Rockford, Illinois: How can such a service be financed? That is the main question. We had that up this morning—the cost of the work. It was just brought up that we should have a stenographer in the operating room.

Laboratory work is admittedly one of the most essential in our hospital service. And how can it be financed? Just how much laboratory work do the attending men want? What laboratory service should a hospital of 75 to 100 beds provide as a minimum standard? Why, you want the best, do you not? You want everything you can have, don't you? And you want the tests made by the most competent laboratory people.

To answer the question, you have to group your hospitals into two groups: the hospital in the small community and the small hospital in the large community where there are a number of other larger hospitals.

In the small community, if the attending men in the hospitals or in that community will make proper use of the laboratory it is going to multiply its service over and over again every single month and there can be no question about financing it. Unfortunately, it becomes necessary for every hospital superintendent, when he has established a first-class laboratory, to begin to educate his attending men to make use of that laboratory. I just had the pleasure this year of installing a laboratory in a hospital of one hundred beds in a community of seventy thousand people with two other hospitals, all small. I think that is one of the crying disgraces—three small hospitals in a community of seventy thousand, with all their overhead, with all their mismanagement, when any one hospital with the same number of beds could take care of all those patients and do it so much better.

We installed a laboratory costing one thousand, five hundred and eighty-eight dollars, equipment enough to take care of a hospital of three hundred beds or more, and we employed an excellent pathologist. We are paying him thirty-five hundred dollars a year and 50 per cent of the net profits. Some of the medical profession felt that a pathologist was not worth more than from twenty-three hundred to five thousand dollars. At those figures we cannot expect men to take up that work. But when the medical men begin to wake up to the fact that that is one of the most important services we have, they will begin to pay pathologists seven, eight, or nine thousand dollars a year. And then you are going to have good work done. We feel that our man would be able to earn at least six thousand dollars a year. How do we finance it? We take the cost of the operation of that laboratory, pro-rate it over our bed charges, and add 50 cents a day. This enables us to give all the laboratory service that the attending men ask for, routine analysis and so forth, anything that he wants is done and as much of it as is wanted. They do not have to ask the patient or tell him it is going to cost more. We figure on a basis of 30 per cent, which means 50 per cent for your smaller hospitals of 40 or 50 beds.

3. *How many hospitals are routinely putting through all the material removed in the operating room and thus checking up diagnoses?*

Dr. M. T. MacEachern: This calls for a show of hands. (Vote taken.) I am glad there are so many.

Right here I want to tell you, you who are building new hospitals, do not forget to put your laboratory next to your operating room and your operating room where your pathologist is at your surgeon's elbow. We have proved its value.

4. *How can the pathologist arouse more interest in the clinicians and internes along laboratory lines?*

Dr. A. K. Haywood, Montreal: There evidently must have been some reason for putting this question on the program and the reason is that the pathologist must arouse more interest

in the clinician and in the interne. If you will show me a hospital that is popular, doing up-to-date work, I will show you a hospital that has a keen pathologist. The pathologist must have a keen interest in the clinician. He must be able to come and decide with the clinician, not in a spirit of criticism but as a consultant, in a spirit of helpfulness, and if you will apply that, you will find that in practically every obscure case your pathologist can be of inestimable value to the clinician. He doesn't examine merely for his own interest or for any financial gain. He examines more and more in his laboratory in order that he may be able to render some service to the patient. He must be confidential, he must be kindly disposed, his criticism should be softened with a certain amount of patience, he must make the interne welcome when he comes into the laboratory. If he is going to arouse interest, he must make them feel welcome at all times to come into his laboratory and chat over obscure or ordinary cases. The pathologist's laboratory is a source of supply for many interesting discussions. It does not matter where the laboratory is situated, if the pathologist is a keen, tactful fellow-being, he will attract the interne and the clinician to his laboratory. In clinical pathological conferences, the pathologist in many cases acts as judge and jury. He can commend and he can criticize, and it is only reasonable, when mistakes in diagnosis have been made and it is necessary for the pathologist to draw the attention of the attending men to them, that he should do that in a manner that is not offensive.

All diagnoses should be made on every case in black and white and put down on the history and the pathologist should insist that the history gets to the postmortem room.

A pathologist will very often forget that he is talking to students and to internes. He must be very guarded so as not to talk over their heads. If the clinicians and internes have implicit confidence in the pathologist, if he is a tactful and kindly pathologist, I do not think that he will have very much difficulty in interesting the clinicians or the internes in laboratory methods.

Dr. MacEachern: Dr. Haywood brought out two points, the sending in of the various diagnoses by the clinicians and internes to the postmortem room, and second, the pathological staff conference. On my way here, I attended for a few minutes one of the conferences referred to, at which the internes and the different members of the surgical service met the pathologist. They meet every Friday morning to discuss the pathology of the week.

A Member: I know a great many pathologists and I know that they differ just about as much as do clinicians. So I believe that the only way to arrive at any conclusion is by hearty co-operation between the pathologist and the clinician. Take any tissue that is removed. We have all had experience. We send it to the laboratory and get a report. Send it to another laboratory and you will get a different report. One of them is wrong. Let us not lose track of this. And let us remember that the laboratory and the clinician must work together.

SECTION D NURSING

1. *Can a hospital attain the minimum standard with what is considered an incompetent nursing staff?*

Dr. Charles H. Mayo, Rochester, Minnesota: We are all interested in the care of the sick which has been greatly changed from ancient customs. The modern methods, proved to be the best, are now accepted by the public. It is only a few decades since hospitals, some in truth hotbeds of infection, were looked on as places to die in, a place of refuge especially for the poor. They are now sought by the intelligent sick who desire the best possible care. No one factor has brought about this revolutionary change. The better knowledge concerning disease and its transmission and prevention, of the educated public who now demand more of the physician, has probably been the greatest factor in bringing about the reorganization: the development of public education in hygiene will be the next great factor.

The trained nurse has given nursing the human, or shall we say, the divine touch, and made the hospital desirable for patients with serious ailments regardless of their home advantages. The rich patient who can pay the price, the poor patient who can pay nothing, may secure the highest service in sickness. But how about the larger group of patients in the middle class, who neither rich nor poor, would be glad to preserve their self-respect by paying to the limit of their ability? The key-note of hospital efficiency today or of any other great movement depending on combined effort is organization. So few hospitals pay their expenses that, like educational institutions, unless they are supported from a bequest, they must be assisted by charity or by the city, state, or some religious or similar organization to make up the yearly deficit. Can a hospital give the minimum standard of care without the most efficient help? The answer is "no" as opposed to public service and the support of

standards of efficiency. Yet, if the hospitals have competent physicians, surgeons, internes, superintendents, and trained chiefs of nurses with intelligent and willing undergraduates much can be accomplished to attain the minimum standard in a comparatively short time. The nursing and care of the sick is a matter of education, and ignorance may be overcome. Knowledge is acquired by a compelling force from within, by desire, or from without, by compulsion. No matter how efficient in general the nursing staff is, the hospital will not be safe and truly serve the best interests of the sick without supervision by some one in authority. This cannot be reversed; the most competent nursing staff cannot replace those who are responsible for the direction or the administration of the organization.

What can be done to maintain the efficiency and save the professional life and dignity of our nurses; can we help them to help themselves? They are compelled to study and labor diligently for 3 years after having achieved a high standard of general education. They are overtrained for nurses and undertrained for physicians. It is true that the training is good for them; the greater number marry, and the wide general knowledge they have acquired is, in fact, of more value to them, their children, and the communities in which they live, than are college degrees, as it contributes to better national health and a more practical citizenship. The records of St. Mary's Hospital in Rochester show that of the nurses graduating for the ten years preceding the last three years, 1 per cent are dead, and 54 per cent are married. Of the class of four years ago, 31 per cent are married. If, then, excluding the last three-year graduates, 2 per cent are out of the work, only 43 per cent are left in the service of the previous ten-year period that has taken the nurses three years of hard, continuous study and work to learn, as long in actual time spent as it takes to study medicine and three to four times as long as it takes to acquire a degree as osteopath or chiropractor. It is evident that the foundation requirements are too high for the average demand, and in all fairness must be made a little higher by specialization, and by giving added responsibilities in positions as technical assistants, or the period of training must be shorter in conformity with requirements for ordinary nursing duty in order that a greater number may obtain the benefit of this educational training.

The course of training should be two years with post-graduate study for the third year, which should be optional, and it should be possible to take it at any time desired, so that those who remain in the work may fit themselves for the work in which there is greater opportunity for service and securing personal distinction. Chief nurse in the hospital, chief surgical nurse, nurse in dressing service, anæsthetist, county, city and school nurse, industrial and child welfare nurse, dentist's aid, physician's aid, and laboratory technician, are but a few of the many positions waiting. It is far from my desire to destroy nursing standards; on the contrary, I wish to advance them for those who remain in the profession with a demand for recognition of ability, responsibility, and honor which will then be accorded.

The patient sends for the physician first. The physician secures a nurse if desired, or he sends the patient to the hospital where a nurse in rotation is assigned by the superintendent. The physician or surgeon must assume the responsibility, even though death occurs from an accident in crae.

Any labor union in which the candidate draws pay or receives only board and lodging while in training, as does the bricklayer, plumber, and carpenter, protects the job by limiting the number of apprentices. In professional life there is some danger in over-organization. The nurse, in accepting unionism, must carefully watch the policies of the organization that they be maintained along professional lines with their legislative efforts directed unselfishly to better care of the sick. As a physician, I am proud that legislative acts sponsored by them, with the one exception of that sponsored by medical anæsthetists, have always been in the interest of public health without thought of advantage to the profession. The physicians' services are always at command for charity, which service the nurse cannot give.

In the interests of the sick I strongly advocate a return to the two-year course as a minimum standard of nurses' training and the development of post-graduate work with a special diploma for advance training. In urging this, I wish to call attention to the fact that in the Great War the medical department under the surgeon-general was developed to the highest efficiency by the valuable aid of the leaders of the department of nurses in Washington, and in the service abroad and at home. Most of the leaders in this group were themselves two-year graduates, thoroughly capable and most devoted to their work.

It has been suggested that those who possess a high-school certificate should be graduated in two years from a course in general nursing, and those desiring training in special branches continue or take such training at a later period. In some

progressive cities, such as Minneapolis, the theory of nursing with the fundamental branches is now given as a vocational training course with 6 months of practical work in a convalescent hospital in the public school system.

2. *Should not all undergraduate nursing service, including especially operating-room and maternity technique, be supervised by competent and experienced graduate nurses?*

Miss C. Lillian Clayton, Director of Nurses, Bureau of Hospitals, Department of Health, Philadelphia, Pennsylvania: Answering Dr. MacEachern's question from the standpoint of the general subject of this afternoon's discussion, my answer should be in the affirmative. Undergraduate nurses should have competent and experienced graduate supervision both from the standpoint of improving the professional work in the hospital apart from the patient and because it provides better service to the patient.

To secure adequate graduate nurse supervision is one of the most important steps in efficient hospital administration. Supervision of undergraduate nurses means much more than the words superficially imply. It means the establishing and maintaining of proper professional relationships between the administration and those supervised, with the patients, the medical service, and all departments related to the wards.

To do this successfully requires tact, ability, education, and experience not possessed by the undergraduate. The value of our nursing service is in large part due to this group of workers. The value of the supervisor lies in her understanding of her own work.

Supervision does not mean interference with those supervised. It does mean, however, that the needs of those supervised most be understood and properly met. These needs are met because the supervisor's own previous education and experience have given her the proper background and her personality makes it possible for her to meet the needs of those supervised because of her own knowledge. In this manner she makes the value of the student greater.

First, because she teaches her accurately to understand the work of the individual in relation to the work as a whole.

Second, because her previous education and experience have made it possible for her to solve problems successfully, she commands the respect of the students and as a result of this the student learns to solve problems for herself. She is not afraid. She does not evade difficult tasks by transferring them to others, or by leaving them undone.

The student enters her work with much interest and youthful enthusiasm. This is priceless to the patient, to the hospital, to society, and to the nurse herself. It must not be lost. It will be lost, however, if she is not taught to use this interest and enthusiasm in the development of herself in her service. One of the great duties of the supervisor is to direct these qualities into the proper avenues of self-expression.

The supervisors form the necessary connecting link between the instruction received in the class room and its application at the bedside of the patient: between hospital administration and co-operation, "between medical science and its actual application when related to the patient." In other words, a supervisor is a teacher who helps. She is the connecting link between science and art; she keeps the balance between theory and practice.

3. *Nurses' records on patients in many instances are useless. What are the essentials of such records, and how can they be made of greater use?*

Miss Katherine Tucker, Superintendent, Visiting Nurse Society of Philadelphia: Certainly there can be little difference of opinion as to the fact that most nurses' records are useless, and therefore the real point of interest is why they are useless and what can be done about it. Too often the records are an expression of the opinions of the nurse and not an accurate statement of her observation of objective facts. Furthermore, the facts noted are the least essential while the truly significant ones may be given a superficial and inadequate description. For instance, the mere statement that a patient had a pain in his side or suffered from a chill leaves unnoted the really important point as to the exact place and nature of the pain and the kind of chill.

Granting the unsatisfactoriness of the present situation, what are the elements considered essential for a complete nurse's record? We can rather take for granted the clinical chart which gives a graphic presentation of the temperature, pulse, and respiration, with a numerical statement of the output and intake, details and description of which should appear in the nurse's notes. The important question, therefore, is what the notes should contain. These should give an accurate description of the patient's objective symptoms with a definite statement of the exact treatment given by the nurse and the patient's responses to such treatment. They should also include a brief statement of other occurrences that might affect the patient's condition. These statements should

not be matters of opinion but a careful description of facts.

Such records will not be easy to procure as nurses as a rule are not articulate in words, being chiefly expressive through their hands. It is necessary therefore to consider whether it is important to have such records and if so, how they can be acquired. They really are of primary importance to the patient as they assure him of the most careful consideration of all that might have bearing on his case. They should be essential to the doctor as developments might occur during his absence of which he cannot be aware except through the nurse's written record. She herself might not remember each significant detail unless she wrote it down. Furthermore, they are of importance to the doctor as a memorandum for future reference. The nurse also would benefit largely from such records as it would increase her interest in the patient and give added importance to her care of each case which would tend to make her more observant and have a tremendous educational value, helping her to correlate theory and practice, thus giving her a more intelligent understanding of her case. If these records are kept as described they should have a scientific value that cannot be overlooked and would contribute to the sum total of our knowledge of disease.

The real question is whether such records can be procured. To my mind the answer is that they can and should be procured; this, however, presupposes a broad foundation. No nurse could keep such records unless she were possessed of a fundamental intelligence and a sound preliminary education, preferably 4 years of high school. Added to this she must have a scientific knowledge which will teach her how to observe. This in turn involves sound teaching during her nursing training. In other words, the whole question of accurate nurses' records which are the right of the patient and should be a necessity to the doctor goes back to the type of woman we must get into our training schools and the kind of teaching we give her when she is there.

4. *What constitutes competent and sound applied nursing service in our hospitals today?*

Miss Mary M. Riddle, Superintendent, Newton Hospital, Newton Lower Falls, Massachusetts: One might say, that nursing service which helps the patients back to normal physical conditions and insures their ability to continue the ordinary pursuits of life and promote their happiness as well as general welfare, must be the soundest applied nursing service our hospitals can furnish today. And that hospital which recognizes these great obligations will lose no opportunity for acquiring equipment, knowledge, and the spirit to render it. Whether the nursing service is given by thoroughly trained and accomplished nurses or by a school of nursing which is an integral part of the hospital, it must be competent or the hospital does not meet its obligation to the patient. When the hospital is dependent upon its school of nursing for all or nearly all of the nursing care given to its inmates, it becomes necessary that the school shall have thorough instruction and competent supervision. If all other things were equal, one would say, or at least naturally suppose, that the best instruction would be given in the largest general hospitals. But since they are not equal, the best instruction is not always given there, though the material for teaching purposes is most abundant.

If the nursing body is accomplished and if the morale is what it should be, if there is enthusiasm for the work, conscientiousness in doing it, and a spirit of humanitarianism manifested or at least possessed by the nurse caring for the patient, whether the nursing service is rendered by pupils or graduates, it must pass into good care. In those institutions where the nursing care has always been given mainly by the pupils or a school of nursing, it has been the custom formerly to expect the most inexperienced beginners to undertake even complex work for the patients, who from the nature of their illness, should have had tender and skilful care and management. All that is now changed, it being the custom in those same schools to have the nurses made familiar with such procedures in the class room before coming in contact with the patients. This change is one of the blessings that have come out of the three years' course, advocates of which believe that practices should be so often repeated as to be done automatically and almost perfectly before the patient is subjected to them, and not only is a patient's comfort an item for consideration in this connection but his safety also, for when the nurse's routine practice is so nearly perfect, she need not concentrate her attention upon it but can keep her mind constantly upon the patient and his condition and thus often protect him from extreme weariness or even a much more serious situation that would really pass unnoticed if she were absorbed by her practice.

The patient should be given the best possible care at the hospital because, first, he needs it, and second, because the hospital by becoming such has positively agreed to give it. So far as the individ-

ual patient is concerned, the purpose is that he may be cured. But so far as the physicians, internes, and student nurses are concerned, there is an additional reason. That is, giving the care as thoroughly and scientifically as possible in order that other patients, future generations of patients anywhere and everywhere, may also have the benefit of their work. Besides the duty of the hospital in furnishing means for the possible cure of its patients, there is another duty it owes the public, and it may be classed under the head of prevention of the spread of disease. To this end it must then so use and suit the materials found in its walls that it can make its contribution to the sick. No small part of the additional work incurred in these procedures necessarily falls upon the nursing staff and it must be prepared for its work by being given suitable instruction. Here, again, may be mentioned another reason for the existence of the three years' course in the training school for nurses since suitable instruction in this as in all other forms of education requires time.

The arousing of the hospital and its staff through the hospital standardization campaign has borne much fruit, and that such efforts at improvement will have a stimulating effect upon the body of graduate nurses and nurse schools in all such institutions is firmly believed. Especially will it be so in those institutions where the student body of nurses is given recognition as an educational factor and where the school is supported, as it should be, by the hospital staff and community and standardization committee, all for the betterment of the sick.

It is believed, to recapitulate, that nursing service is best which contributes most to the ultimate recovery of the patient or, when recovery is impossible, which finds the patient every available comfort. It is believed that the most satisfactory nursing is done in the larger general hospitals and in those of secondary size by students of a well-equipped, well-managed, and well-instructed school of nurses. The old hospital slogan that "Nurses are created for the patients," must be amended to read, "for these and future patients, anywhere and everywhere, as well as for those whom we can help to avoid being patients." The nurses, therefore, must be trained to meet all such requirements, and 3 years are none too long for the purpose. It is the duty of the hospital to see that the student nurses get a just return for their efforts in its behalf. It is the nurse's duty, as well as privilege, to give her very best service to the patients and to carry out zealously all orders or directions for their care and treatment. If standardization does as much for the schools of nursing as it has done for the hospitals, it will certainly be welcomed by the schools.

The greatest need in the suffering world today is for young women of good breeding, of good education, and of fixed principles of righteousness, which when added to good training will make an army that will be invincible before selfishness, negligence, and profiteering.

Let the hospitals give them what they seek. Let the community give them a place in it. Let them be honored, let them be crowned with honor, and the dearth of them will disappear.

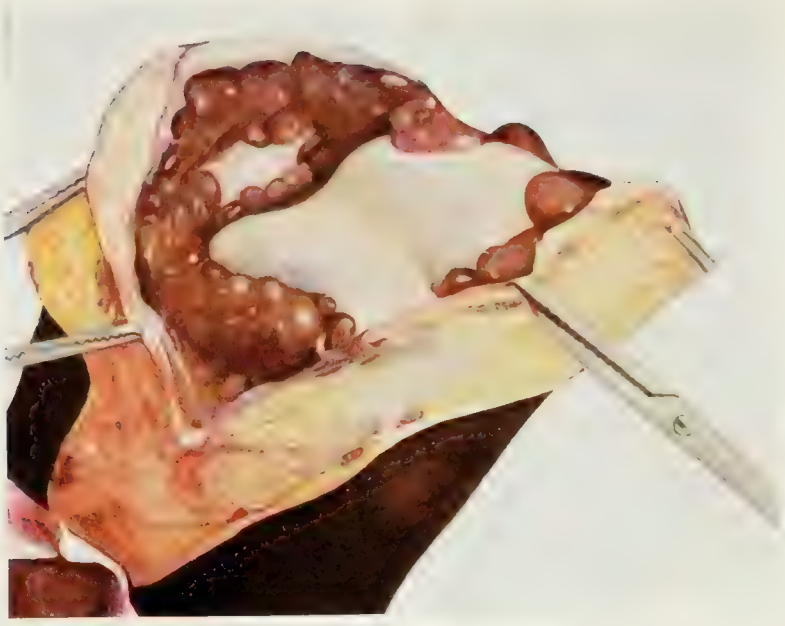

Fig. 1. Joint as seen at operation.

Fig. 2. Gross specimen

Synovial Membrane Tumors of Joints.—Frank W. Hartman.

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SYNOVIAL MEMBRANE TUMORS OF JOINTS

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TUMORS of the synovial membranes of the tendon sheaths are now easily recognized, some one hundred and twenty cases having been reported in the literature. The great majority of these occurred on the fingers and toes with no history of recurrence or of metastases after local excision.

The unusual and puzzling pathology of this group of tumors is evidenced by the names under which they have been described: granuloma, myeloma, myeloid tumor, myeloxanthoma, myeloid endothelioma, fibro-angioma, giant-celled tumor, giant-celled xanthosarcoma, and benign xanthic extraperiosteal tumors of the extremities containing foreign body giant cells.

Exhaustive as has been the study and discussion of these tumors arising in the synovial membranes of the tendon sheaths, the tumors primary in the synovial membranes of joints have not been compared or identified with them. Sixteen such joint tumors are recorded in the literature and they will be briefly considered with my own observation.

The growths are most readily classified in three groups:

1. Pedunculated tumors;
2. Diffuse tumors with giant cells;
3. Diffuse tumors with no giant cells.

There are four cases in group 1.

Gustav Simon describes the first of this series in 1865. The patient was a male, age 46, who had had an impaired knee joint for 6 months. Examination showed a mass the size of the patella in the inner aspect of the knee. It was readily excised and function fully restored.

The tumor mass measured 5 by 1 by 1.5 centimeters. It was smooth, glistening, reddish white in color, and soft and elastic in consistency. Microscopic examination of the tissue showed it to be composed of spindle and irregular-shaped, pigmented cells with oval nuclei, large giant cells, and occasional fatty cells. It was quite vascular.

Diagnosis: hypertrophied sarcomatous synovial fringe.

The case reported by Aunendale and Turner was a female of 23 admitted with pain in right knee, which had existed for 8 months and at times gave sharp pain. There was a small movable body on the lateral side of the joint near the site of the external semilunar cartilage. At operation a small pedunculated tumor the size of a horse bean, attached to the synovial membrane, was revealed. The pedicle was ligated and cut through.

Diagnosis: myeloid sarcoma (Woodhead). There was no recurrence after 8 years.

Weir presents patient, age 24, complaining of pain, stiffness, and swelling in the left knee, which had lasted for a year. There was no history of trauma. Some pain was occasioned by walking, but the joint at times catches with sudden piercing pain. The lump the size of a bean was easily made out internal to the patella. There was fluid in the joint.

Operation—The pedicle was ligated and the tumor excised. All pain and swelling soon disappeared, and perfect function was restored. Sections showed small round and spindle cells with scanty stroma, many giant cells, and much blood pigment scattered throughout. The tissue was quite vascular.

Diagnosis: sarcoma with giant cells. Recovery.

His second patient is male, age 39. Complaint—loose cartilage in left knee joint. Limp had been present for 3 years, and was aggravated after dancing. Cartilage measured three-quarter inch in

Fig. 3. Appearance of author's case before last operation.

diameter. At present he has periods of painful fixation for several days, preventing walking.

Operation revealed a mass irregular, soft, yellowish-pink in color and marked by sundry ecchymotic patches on its surface and attached by a long pedicle. The pedicle was tied and cut. The tumor measured 1½ by 1 by ¾ inches. It looked like a mass of fat containing hæmorrhages. It consisted of connective tissue containing in its meshes round and spindle cells and much blood pigment.

Diagnosis: fibrosarcoma. Recovery.

In three of these, symptoms had existed less than 1 year; in the one they had existed for 3 years. The joint was opened in each and the tumor excised, with history of recovery in three.

There are four cases in group 2 in addition to the one which I desire to record.

Moser's tumor occurred in the tibiotarsal joint of a female, age 38. There was a history of pain in this foot for a period of 2 years. Examination showed a diffuse growth extending from one malleolus to the other. The tumor moved in forced extension of flexion of the foot but it apparently did not involve the tendons. At operation the tendons were easily freed and retracted, exposing a circumscribed tumor springing directly from the tibiotarsal joint. Recovery was uneventful. No recurrence in 7 years.

Diagnosis: sarcoma with giant cells.

Despite the pathologist's report of sarcoma, Dowd presents his case under the title: "Villous Arthritis of the Knee."

Male, age 38, complains of swelling and disability of right knee. He had been treated with bandages and counter-irritants, had had swelling and partial loss of function for 4 years. The knee showed diffuse swelling. A patellar click was present. Flexion was limited and there was a mass on either side of the patella.

At operation many villi were found, the largest measuring 2 by 1½ inches. Villi arose from many parts of joints, giving the appearance of a bunch of grapes. As many of these were excised as possible, the joint washed out with saline and closed. Recovery was uneventful.

Pathologist's report. There were many small bodies having papillomatous projections attached to main tissue by fibrous bands. The cut surface of each is smooth and contains small masses 3 to 5 millimeters in diameter separated from each other by fibrous capsules. They can be shelled out and appear cartilaginous. Microscopic examination shows that the periphery consists of an infiltrated, vascular, fibrous tissue. The mass of tissue is composed of closely packed cells mostly spindle- or oat-shaped. They are separated into smaller ones by fibrils of connective tissue. Scattered about are giant cells. Blood vessels are numerous and for the most part have good walls, but there are many smaller blood spaces enclosed simply by tumor cells. Mitotic figures are present.

Diagnosis: giant-celled sarcoma.

M. M. Lejars and Rubens-Duval, male, age 22, admitted to the hospital, complaining of a large bloody tumor of the knee. At the age of 16, he had a sharp unexplainable pain in the left knee which had been uninvolved in a previous attack of rheumatism. Three years ago, he received a blow on the knee, since which time it has been more painful. The joint was opened and drained without relief. Following this, the cautery was applied and iodine injected into the joint. The knee became progressively larger and an ulceration, in which several tumor masses presented themselves, appeared. At the time of this operation, the knee was twice the normal size and apparently dislocated backward. The leg and thigh were atrophied. X-ray was negative. An arched incision was made showing the joint filled with greyish yellow masses of varying size. There was no necrosis or abscess formation. The articular surfaces were intact but there was a small erosion of the external condyle of the tibia 3 centimeters in diameter. All affected tissue was excised, the erosion curetted, and the wound closed with a drain. At the end of a month, there was a local recurrence at the external angle of the wound which was excised and found to be like previous tumor masses removed. Three months after this second operation, several recurrent masses were palpable and thigh amputation was done. Examination of the gross specimen revealed not only recurrence in the joint but several plaques of greyish tissue in the bones.

There were two distinct elements composing the tumor: the first, fasciculæ of the larger spindle cells; the second, gland-like tubules lined by one or more rows of cuboidal or cylindrical cells. These tubules in some instances contain mucin within their

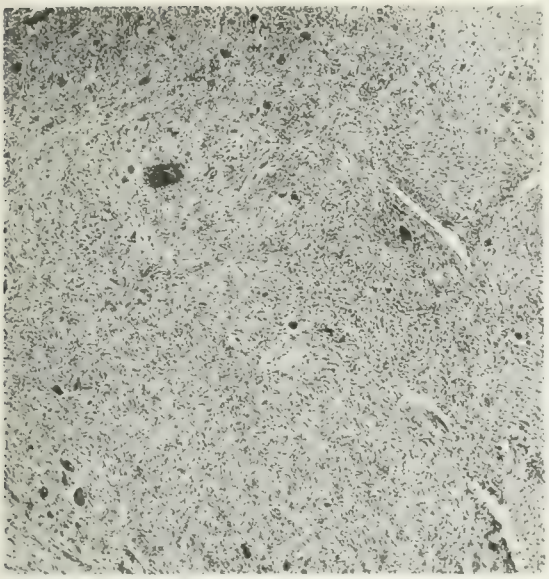

Fig. 4. Low power section from larger nodules showing very cellular tissue with many giant cells.

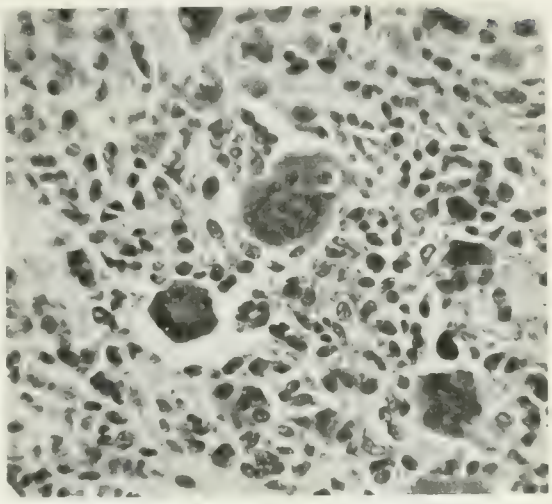

Fig. 5. High power. Same as Figure 4. Note absence of mitotic figures in the giant cells.

lumina. Some areas show the two elements intermingled, while again areas show definite transition of one type of tissue to the other. Masses of undifferentiated protoplasm are seen here and there. The fat seems to have been absorbed from the adipose tissue and replaced by pigmented granules of lipochrome.

My own case occurred in the knee joint of a male age 20. Some swelling and pain of aching character were noticed after prolonged use, 4 years before our first observation. In another clinic the joint was aspirated twice a week over a period of 2 months, and at each aspiration 50 cubic centimeters of cloudy, blood-stained fluid was obtained. A diagnosis of villous arthritis was made.

At this time there were no visible or palpable lumps about the knee. A longitudinal incision was made on either side of the patella. Fluid and "loose bodies" were said to have been found. At the end of 4 months patient was discharged. There was enlargement of the joint, and it could not be flexed as far as the other, but it was free of swelling and pain for 3 years. The patient first presented himself to us with severe pain and sudden giving away of this joint. It was particularly troublesome while walking or drilling. Upon examination the joint was swollen, very painful, and the patella was floating. Rest and local applications reduced the swelling so that a mass 1½ centimeters in diameter could be made out on either side of the patella (Fig. 3).

The scar on the outer side of the knee was excised and the joint opened through this wound. One of the large palpable tumors and many smaller ones all springing from the synovial membrane, presented in the wound. These masses were firm and elastic. Their surface was reddish brown or grey in color and rather granular. About 50 cubic centimeters of thick blood-tinged joint fluid escaped. The large mass was excised for examination and the wound closed. The cellular nature of this specimen seemed to justify further intervention. Five weeks later the joint was opened by horse-shoe incision, exposing the joint as seen in frontispiece. The masses were all within the joint capsule and attached to the synovial membrane as villi. They were much alike in consistency but varied in size from that of a split pea to a walnut. For the most part they were reddish-brown in color but a few were faun color. The entire joint capsule was thickened and reddish-brown in color. The articular surfaces were not involved, but the semilunar cartilages, crucial ligaments, and capsule were so completely infiltrated that resection was done, and the wound washed out with Harrington's solution followed by alcohol. Recovery was uneventful.

Pathology. The specimen consists of the thickened joint capsule, synovial membranes, cartilages, and ligaments. The surface of the capsule is brown with pigment, granular rather than smooth and glistening, and quite friable. On section the pigment is seen to extend 2 millimeters into the tissue. The synovial membrane is crowded with smaller and larger villi. These have granular pigmented surfaces and are firm and elastic in consistency. Cut surface shows less pigmentation and the deeper portions are tougher, apparently containing more fibrous tissue. The base of the cartilages and the ligaments are pigmented, the latter being friable (frontispiece). Microscopic examinations of sections from the largest nodules show them to be cellular and abundantly supplied with smaller and larger thick walled blood vessels. Considerable pink-staining fibrous stroma

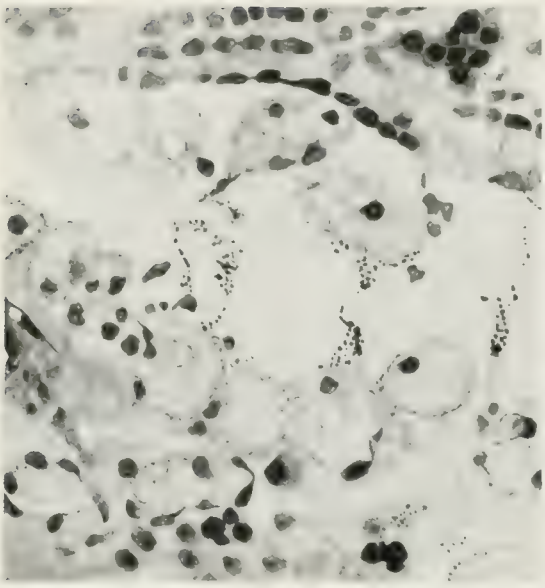

Fig. 6. Drawing of area showing character of the foam cells. Frozen section.

is seen in places. The cells are of three types: A round cell, the size of a large mononuclear with vesicular nucleus and abundant protoplasm which in many cases is filled with granules of brownish yellow pigment, a large oval or rectangular cell with small blue-staining nucleus and a great amount of almost clear granular protoplasm scattered throughout, singly or in collections of various sizes (Figures 4 and 5) and occasional giant cells with multiple nuclei and deep blue-staining granular protoplasm.

The second type of cell is the foamy or xanthona cell and in frozen section the protoplasm appears as a mass of bubbles, Figures 6 to 10, which are doubly refractile when viewed with crossed Nichol's prism. These give no reaction for fat when stained with osmic acid. After standing mounted in glycerine, the bubbles crystallize into sheaves of needles. When extracted with alcohol and recrystallized, they are typical cholesterine crystals.

Sections from the friable brown joint capsule show it to consist of minute, elongated folds containing numerous large blood vessels. The surface of these folds is covered by blue-staining granular protoplasm which contains numerous vesicular nuclei, but the cell outlines are poorly defined. Some areas show elongated gland-like structures lined by masses of this tissue, the lumina of which are filled by homogeneous faintly staining material.

Sections from the smaller synovial fringes show all the cell elements seen in 1. Here and there collections of red blood cells are seen free in the tissue. The brownish yellow pigment appears in great quantity both intra- and extra-cellular. This gives positive staining reaction for iron. These fringes are

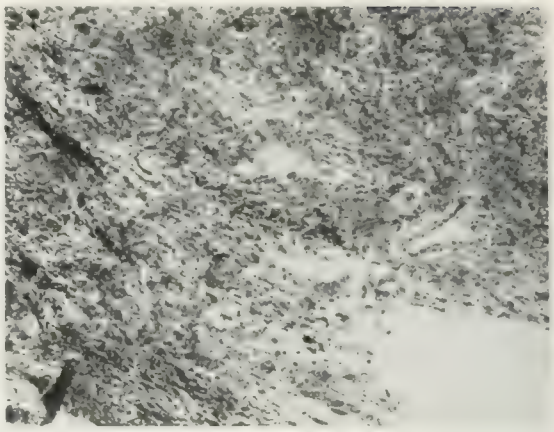

Fig. 7. Low power photomicrograph of area in Figure 6.

covered by undifferentiated tissue like the surface of the joint capsule. Here, indeed, some large masses of protoplasm contain no nuclei while others contain from one to sixteen.

Of this group one is of the tibiotarsal joint and three of the knee joint. They had existed from 2 to 14 years previous to operation. Two cases cited recurred after the primary operation. The history of drainage, aspiration, injections of iodine and repeated local excision gives a clue to the active cell proliferation, and may have been directly responsible for the metastases noted in Lejars and Rubens' case.

As pointed out by various pathologists, particularly by Mallory, we have two types of giant cells in tumors, one containing large irregular nuclei and mitotic figures signifying the extremes of malignancy and rapidity of growth, the other formed by the fusion of wandering cells or lymphocytes which play an active part in the phagocytosis of foreign material and are spoken of as foreign body giant cells. These latter cells may be found in almost any type of chronic inflammation or tumor formation, but are especially abundant in tumors associated with bones as medullary giant cell tumor and epulis. In such very malignant tumors as the spindle-celled sarcoma of bone, both types of giant cell may be seen.

The giant cells observed in synovial membrane tumors, as above described, are obviously of the foreign body type.

The yellow brown pigment, both intracellular and extracellular, which gives the characteristic color to the tissue, doubtless is derived from the numerous extravasations of blood seen throughout.

The foam cell is striking especially when seen in frozen section but it is peculiar only in that it has phagocytized cholesterin formed by tissue degeneration, and retains it probably in a fluid crystalline state.

Too much importance has been given the foam cell and the giant cell in the classification of this group since both may be absent from otherwise typical tumors arising in the synovial membranes. This fact is well illustrated in the nine cases comprising the third group.

George Turner. Male, age 28, with tumor of tibiotarsal joint. Operation showed there was no connection with the tendons. The tumor apparently arose from the synovial membrane and was diagnosed as sarcoma.

Lockwood. Young female, tumor of the knee for 3 years. Clinical diagnosis—tuberculosis; hence, local treatment was applied for some time. It became progressively larger and more painful so that resection of the joint was done. The joint contained no pus and the articular surfaces were not eroded. Diagnosis: spindle-celled sarcoma.

Blumethal. Woman, age 29. Slight pain and functional disturbance in knee-joint. Resembled Hoffa's fatty hyperplasia clinically. Diagnosis: primary sarcoma of the knee-joint. Capsular extirpation was done. Microscopic study showed "large celled" sarcoma. No recurrence in 2½ years.

Anton R. von Rudiger-Rydygier. Female, age 20, suffered from enlargement of the left knee for 2 years. During this time there was no pain. For 3 months there had been considerable pain and more swelling. Aspiration yielded 1,100 cubic centimeters bloody fluid the first time, and 600 cubic centimeters a week later. Clinical diagnosis was tuberculous arthritis. Aspiration yielded no improvement. The tumor was the size of a child's head, quite elastic and fluctuant. There were no metastases, and the skin was intact. X-ray examination was negative. Diagnosis: sarcoma of the knee. Operation showed the bone and cartilages of the knee to be involved. The joint capsule was very much thickened and covered by small pedunculated tumors the size of kidney beans. The lateral ligaments were infiltrated by the new-growth. The joint was resected and the entire capsule removed. Histopathology: small round celled sarcoma. There was no recurrence.

Julliard and Descoeudres. Female, age 35, developed a small, somewhat painful tumor on the internal surface of the right knee. Examination showed several nodular elastic masses about the joint with some fluctuation in front. There was no pain on pressure. X-ray examination was negative. Aspiration yielded 500 cubic centimeters of yellowish ropy fluid. This reforms rapidly. Clinical diagnosis: tuberculous arthritis or malignant tumor. Operation showed the tumor to be adherent to the patella joint capsule and tendons. The entire joint was resected although the articular surfaces were not affected. Death followed in 5 weeks from infection. Autopsy revealed no local or remote metastases.

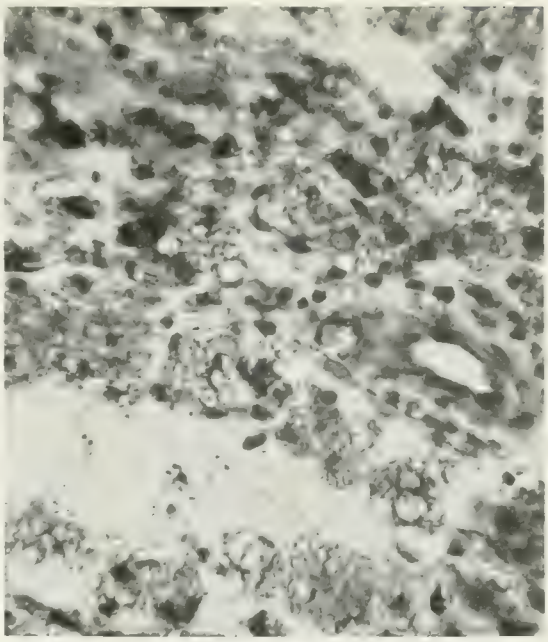

Fig. 8. High power of area seen in Figures 6 and 7.

Howard Marsh. Man, age 21, presented tumor on inner side of left knee close to articular border, the size of a small tangerine. Clinical diagnosis: tuberculous periosteitis. Operation proved it to be new-growth of synovial membranes. Microscopic examination showed mixed spindle- and round-celled sarcoma. Five local recurrences during a period of 3 years were excised. Thigh amputation was done because of pain and loss of function. Inguinal glands were not involved. Patient remained well.

Hardie and Salter. Male, age 25, suffered with pain in left knee for 5 years. Hydrotherapy gave some relief. Tumor the size of a marble appeared 2 years ago and has increased until now there is a soft, doughy mass 3 inches in diameter over the outer side of the joint. Operation showed the joint filled with granular roe-like material, and the synovial membrane reddened and thickened. The swelling contained grumous fluid and venous-colored, soft, friable material like fish roe. Near the tumor proper was a cluster of bean sized, white bodies. The head of the tibia and cartilages were slightly eroded. Diagnosis: spindle-celled sarcoma. No recurrence.

Fig. 9. Low power. Large areas of foam cells in fixed pecimens.

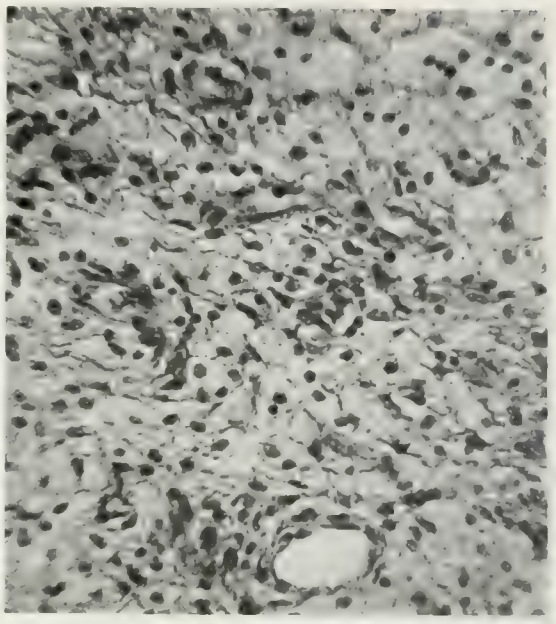

Fig. 10. High power. Same as Figure 9 showing how the lipoidal substances are dissolved by alcohol fixation leaving only the nuclei and the cell membrane.

Garre. Female, age 34, left knee had given pain on walking and especially while climbing stairs for a period of 4 months. The left knee was swollen, being 37 centimeters in circumference as compared with the right, which is 30 centimeters. Superficial veins were dilated over the swollen part of the joint. On either side of the quadriceps tendon there was a large, solid tumor mass. The popliteal space also contained a firm tumor mass causing pressure on the vessels in this region. Clinical diagnosis: tuberculous arthritis. An operation joint capsule was seen transformed into a toughened and thickened mass. It was irregular and dirty in color, resembling the adrenal cortex. Patella and condyles were enveloped in the thick capsule but the bone was uninvolved. The semilunar cartilages were intact. Thigh amputation was done. A yellow mass of tissue resembling that removed from the joint was curetted from the medullary canal of the femur. Two weeks after operation, there were extensive metastases in the inguinal gland. Death occurred at the end of 4 weeks with metastases in the clavicle, liver, and lungs. Diagnosis: Sarcoma.

Hermann Kruger. Female, age 67. Rheumatism of left knee for 6 years. There was progressive enlargement of the knee and three nodules below the knee. These were excised with inguinal glands. Within a year three more tumor masses appeared about the knee; there was no glandular enlargement. At this time a diagnosis of fibrosarcoma of the joint capsule was made. The tumors and joint capsule were completely excised. One and one-half months later a hard tumor mass the size of a hen's egg occurred on the medial side of the joint. Six months subsequent to this a tumor the size of an apple appeared in the popliteal space which was attached to the joint capsule. At this time amputation was done and it was found that the condyles of the tumor were infiltrated. Diagnosis: vascular fibrosarcoma.

In this group the duration was from 4 months to 6 years. The symptom of onset was pain in five, tumors in three, and interference with function in two. A primary diagnosis of tuberculosis was made in five. The history of slow, insidious onset and slow development is noted here as in groups 1 and 2. There is no record of ultimate result in two. One died of infection, showing no metastases at autopsy. Four were cured by capsular extirpation, joint resection, or thigh amputation. Kruger's tumor recurred and infiltrated the condyles of the humerus. Garre's patient died of remote metastases.

DISCUSSION

The occurrence of this tumor in joints and especially in the knee joint raises at once the problem of saving the limb and the function of the joint. Their development is slow as a

rule and ample warning is always given in the form of pain, swelling, and interference with function. They are readily removed, if attacked in the early pedunculated stage, without danger of local recurrence or remote metastases.

As to classification, it seems best, to place them with the benign tumors of connective-tissue origin since the giant cells are of the foreign body type and no mitosis is seen. However, there is a potential malignancy as demonstrated in the patients of Lejars and Rubens, of Kruger and of Garre. Palliative measures and incomplete excision are contra-indicated and are perhaps responsible for the malignant characteristics developed in these cases.

These neoplasms should not be termed sarcoma at least until evidences of malignancy are seen either clinically or pathologically. Since any one of the characteristic cells, namely xanthoma or foam cells, pigmented cells and giant cells, may be absent from an otherwise typical case, the writer prefers the name used by Woodhead, myeloid tumor.

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CARCINOMA OF PROSTATE

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CARCINOMA of the prostate presents as many complexities of diagnosis and treatment as any other disease of the urological tract. The internal situation of the prostate, the confusion between carcinoma and adenoma, the quiet, often symptomless, invasion of the prostate by the carcinoma, the urinary retention, the conflict between operative and radium treatment—these are some of the phases. In this paper only the most important problems of diagnosis and treatment are considered. It is especially an attempt to bring up to date the report of radium therapy in carcinoma of prostate as practiced at the Memorial Hospital.

GROSS PATHOLOGY—TYPES OF MALIGNANCY

The two following histories with their postmortem data represent two types of malignancy between which extremes all variations occur.

Case 1. J. S. W., age 60, admitted to Memorial Hospital, September 11, 1919, with a history of frequency of urination and prostatic retention for a number of years.

The examination of his prostate (by rectum) revealed a very large, irregular, stony hard prostate fixed to the pelvis. Indurated masses extended along the right and the left vesicles. The top of these masses could not be felt. The patient was very thin and cachectic. Residual urine 4½ ounces. Radium had no effect that could be determined by palpation upon the carcinoma. Patient gradually grew worse and died December 3, 1919. The postmortem record showed: "Kidneys—ascending suppurative pyelonephritis; prostate—measures 4 by 5 centimeters laterally and 2½ centimeters vertically. Structures are obliterated by opaque tumor tissue which fungates, through base of bladder at trigone, 3 centimeters wide. Rectal wall is slightly adherent but not involved. Peritoneal surface behind bladder base shows superficial subserous nodules. *No enlarged lymph nodes were found.* The carcinoma has not extended above the seminal vesicles."

Case 2. J. S., age 74, admitted to Memorial Hospital, August 24, 1916. His chief complaint was a tumor mass on left jaw. Seven months previously he had had a severe facial neuralgia, and then a small lump appeared on the left cheek anterior to ear. The lump increased in size. Patient lost weight and strength rapidly, 34 pounds in a "short time." Lately he has had some "stomach trouble." The physical examination showed: no teeth in either jaw; above left molar region of inferior alveolar process is a small area of tumor the size of a 5-cent piece. Extending into adjoining buccal mucous membrane is a hard tumor growth which involves the whole side of the inferior maxilla producing a large tumor of the left cheek. The tumor is hard and fixed to the inferior maxilla. Rectal examination showed the prostate slightly enlarged and very irregular. The left lobe was larger than the right. Small, hard nodules appear on surface, but there is no perivesical enlargement. Diagnosis: *probably primary prostatic carcinoma* with metastases to jaw.

The postmortem showed: kidneys, left pyelitis and chronic productive nephritis; right pyelitis. The bladder showed chronic suppurative cystitis. The left lobe of prostate was slightly enlarged and showed pea-sized nodules projecting from the posterior surface. At entrance to prostatic urethra surrounding orifice were a few soft, pea-sized papillary projections. Running up the spinal column was a series of slightly enlarged lymph nodes becoming more marked in the thorax, and replaced by soft tumor tissue. In the thorax, the process from lymph node invaded the body of the fourth and fifth dorsal vertebræ. This process encircles the spine and invades the periosteum of the sixth and seventh ribs largely destroying both. The entire left inferior maxilla is destroyed by a soft tumor process, which invades the periosteum and replaces bone. Diagnosis: carcinoma of prostate; secondary carcinoma of inferior maxilla by invasion through spinal lymph nodes.

In the first case (of low malignancy) notwithstanding the time the disease had been present and the very large prostatic carcinoma, the carcinoma did not go above the seminal vesicles. In the second case (highly malignant), the changes in the prostate were so slight as to make the diagnosis of carcinoma only "probable," yet the metastases were very large and extensive.

Both of these extreme types are rare and all gradations between these are seen. The usual type is a slowly growing tumor which, because of the limiting fascia of Denon-

villiers on the one side and the bladder base on the other, generally grows in the line of least resistance, upward into the lymphatics around the seminal vesicles, and metastasizes very early in its life history.

FREQUENCY OF GROWTH BEYOND THE PROSTATE IN 145 CASES

In 2 cases the carcinoma, as far as could be determined by palpation, was confined to the prostate; a third case was borderline. The remaining 142 cases showed extension either toward the vesicles to the bladder, to the lateral walls of the pelvis, or metastases to more distant parts of the body.

Lateral pelvic extension. The commonest extension of a prostatic carcinoma is toward the seminal vesicles. A second, not uncommon extension, may be to the lateral pelvic walls. From either prostatovesicular junction, a bridge of dense carcinomatous tissue is felt extending to each ramus of the pubes. This is a common extension and one not usually described.

Rectal extension. There were but 3 cases of growth of the carcinomata through the rectal wall at the site of the prostate. This growth was accompanied by vesicorectal or urethrorectal fistulæ and was not to be confused with the perirectal growth often occurring above the seminal vesicles and causing rectal stricture.

Anterior urethral metastases. One of the 145 cases had metastasis in the anterior urethra. This was either a retrograde lymphatic growth or a direct implant into the urethral mucous membrane. In this case metastasis occurred after a Young punch operation on the bladder neck. Carcinomatous tissue broken loose might have formed a transplant. This patient also had a secondary nodule of the head of the penis.

I have seen one other case which had a periurethral metastasis some centimeters back of the head of the penis. In this case there had been no operation on the prostate or urethra.

Distant metastasis. Our records are too imperfect to determine how frequently prostatic carcinoma metastasizes to the pelvis, lumbar spine, lungs, long bones, glands, etc. Bumpus[1] has lately published records on the frequency of these metastases.

PROSTATIC CARCINOMA SECONDARY TO BLADDER CARCINOMA

A bladder carcinoma usually starts in the mucous membrane of the bladder, and grows in the line of least resistance, that is, into the cavity of the bladder. Nothing hinders its growth in this direction. So having ample space within which to grow, it metastasizes late. When the bladder contracts to expel urine, the mucous membrane folds up and there is not much pressure exerted upon the tumor. A prostatic carcinoma on the other hand has no space in which to grow. In addition to this it is limited posteriorly by the dense fascia of Denonvillier and anteriorly by the less dense fascia of the bladder base. This tension, so to speak, in which the prostatic carcinoma is held, is one factor in causing it to extend beyond the prostate and metastasize early, and it metastasizes or extends most often upward between these two limiting fasciæ. Probably a contributing factor to early metastasis is the pressure exerted upon the carcinoma when the bladder sphincter contracts at the end of each act of urination. Because of these conditions it is rare for a bladder carcinoma to grow by the difficult route and invade the prostate, but rather common for a prostatic carcinoma to break through the fascia at the bladder base and invade the bladder. The following case is the only one of the series in which the picture was that of prostatic carcinoma but the pathological report showed a squamous-celled carcinoma undoubtedly originating in the bladder.

G. G. H., age 60, first seen July 5, 1920. In October, 1919, he suffered with frequency of urination. February, 1920, he became impotent. He never had hæmaturia.

The prostate shows a hard tumor mass of the posterior lobe of the prostate 2½ by 3 centimeters, stony hard, fixed, and irregular and one cannot feel above the prostate to determine the condition of the vesicles. He has complete retention of urine.

In December, 1920, a suprapubic prostatotomy was done to relieve retention of urine. All around the internal urethral orifice were irregular carcinomatous nodes, very extensive, forming valleys and

[1] Carcinoma of the prostate. Surg., Gynec. & Obst., 1921, xxxii, 31.

hills. The whole bladder base was indurated, a typical picture of a prostatic carcinoma growing into and behind the bladder wall. The patient died uræmic, in January, 1920. The pathological report (Dr. Ewing) follows:

"The tumor has the structure of an epidermoid carcinoma, the cells being broad, flat, and mostly of distinctly squamous character. It shows none of the glandular features of prostatic carcinoma, and it appears quite improbable that it has any other origin than from the bladder mucosa.

"The radium changes are notable. The first changes consist of extreme swelling and hyperchromatism, often followed by disintegration of the nuclei. Many of these cells form giant masses. Hydropic swelling is also present. Later the cell groups break up, and become very hydropic, while the surrounding connective tissue reacts with production of much cellular granulation tissue. Finally the tumor cells disappear, often leaving giant cells or points of necrosis, much resembling miliary tubercles."

EARLY SYMPTOMS

1. *Disturbance of urination.* Of 145 cases, 115 had as a first symptom either dribbling, dysuria, nocturia, frequency, difficult urination, or retention, or a combination of these; 11 had, as a second or subsequent symptom, some disturbance of urination.

2. *Hæmaturia.* Eight had hæmaturia as a first symptom, and 25 as a second or subsequent symptom. Of 33 cases which had hæmaturia as a symptom it is definitely stated that the bladder had a secondary carcinoma in 18.

3. *Pain* (not associated with urination). Seven had pain as a first symptom—3 in the back, 1 back and hip, 1 pain in heel, 1 in prostate, 1 abdomen; 5 had pain as a second symptom. One had pain in groin, 1 pain in buttocks, 1 sciatica, 1 in thigh, 1 in leg.

One patient had as a first symptom œdema of legs; 1, a swollen testicle; 1, constipation; 1, bleeding from rectum.

There is nothing in the symptoms that can distinguish carcinoma from non-malignant enlargement of the prostate, although in the latter a history of hæmaturia is somewhat more frequent.

AGE—129 CASES

30 to 40 years	2
40 to 50 years	5
50 to 60 years	33
60 to 70 years	59
70 to 80 years	27
80 to 90 years	3

Here again the age incidence runs nearly parallel to that of hypertrophy of the prostate.

TIME ELAPSED BETWEEN TIME FIRST SEEN AND THE FIRST APPEARANCE OF SYMPTOMS

In 93 cases of prostatic carcinoma with the growth extending beyond the prostate, the time elapsing between time first seen and the first appearance of symptoms is—

1 to 2 months	15
2 to 4 months	12
4 to 6 months	11
6 to 12 months	19
12 to 18 months	7
18 to 24 months	8
24 to 36 months	7
36 to 48 months	4
48 to 60 months	6
60 to 72 months	3
72 plus months	1

One unusual case was that of a patient with extensive carcinoma of the prostate who had a prostatectomy for prostatic carcinoma 9 years before.

The hopelessness of curing many cases of carcinoma of the prostate if we do not radically change our method of approach is shown by these figures. Notwithstanding that 1 out of 7 cases came within the first 2 months after the appearance of symptoms, that 1 out of 3 cases came to us within 6 months, and 2 out of 3 within the first year of symptoms, in all of these cases the carcinoma had grown beyond the prostate. *We are inevitably forced into the conclusion that regular examination of the prostate of all beyond the age of 50, irrespective of the appearance of symptoms, is the only rational method whereby we may hope to get these cases early.*

EXAMINATION

The routine examination includes rectal palpation of the prostate with a thin-gloved finger, with and without a sound in the urethra. Special attention is paid to perivesical induration, or lateral bands to the pelvic walls. Stricture of the rectum occurs high above the vesicles as pointed out by Geraghty, and normally can just be reached with the tip of the finger. The superficial lymph nodes are palpated as is also the penis, for carcinoma. Any swelling of the legs is noted.

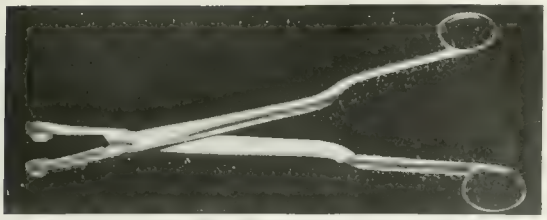

Fig. 1. Punch used for suprapubic removal of carcinomatous prostatic base.

The amount of residual urine is measured as also the kidney function. Cystoscopy is done. It is not practicable to radiograph the whole body for metastases to the bones. As metastasis most often attacks the lumbar spine and pelvis, one roentgenogram is taken showing both of these. This roentgenogram may also be used to exclude stone of the prostate, the one condition which most simulates carcinoma. I have on one occasion used a long needle inserted through the perineum into the prostate (novocaine anæsthesia) to make the differential diagnosis between stone and carcinoma. We found that the needle very distinctly grated upon the prostatic stone. Of the 145 cases of prostatic carcinoma seen at the Memorial Hospital, I have never come across a stone in the prostate. And in all of these the prostatic region had been either radiographed or needled.

PATHOLOGICAL EXAMINATION

We have developed at the hospital[1] a needle which has proved to be of value in the diagnosis of doubtful cases. This needle has a small cutting screw at the point with which prostatic tissue is obtained. The needle is inserted through the perineum (novocaine anæsthesia) into the prostate, a finger in the rectum guiding it. We have used this needle 33 times, in 16 of which prostatic tissue was obtained, 9 of these proving to be carcinoma. It should only be used in cases in which the diagnosis is in doubt.

TECHNIQUE OF RADIUM APPLICATION

1. *Prostate needle.* The technique first used at the Memorial Hospital in October, 1915, is still with us the most efficient and least painful method of destroying carcinoma of the prostate. A steel needle 10 to 15 centimeters long of No. 18 gauge is used, 50 to 100 millicuries of radium are placed in the end (terminal 3 centimeters) of the needle. Under novocaine anæsthesia with a guiding finger in the rectum the needle is inserted through the perineum into one of the lobes of the prostate. Then at the end of the treatment for that lobe the needle is withdrawn from the prostate (but not entirely out of the perineum) and inserted into the second lobe. A carcinomatous mass 2 centimeters in diameter will stand an initial radium dose of 300 to 400 millicurie hours. This may be repeated in smaller dose in 2 to 3 months. We have in certain cases used smaller doses at shorter intervals (25 to 50 millicuries every week). But I have no evidence that this method does any more than the above.

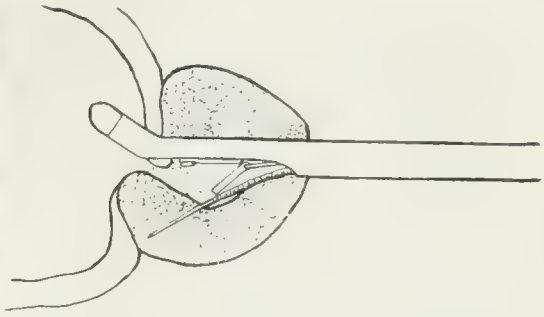

Fig. 2. Method of inserting bare tubes of radium into carcinomatous prostatic base to relieve residual urine.

2. *Seminal vesicles—needles.* The seminal vesicles are radiated routinely if the size of the prostate does not prevent their being reached. Sometimes they are more easily reached through the rectum than by the perineal route, and in some cases we have so radiated the vesicles. A guiding finger is put into the rectum, and a small cannula is inserted up to the vesicles. The needle is put through the cannula, and so into the vesicle. The lower rectum is previously cleansed with soap and water. We have had no infections of the vesicles following this rectal method.

3. *Bare tubes in prostate and seminal vesicles.* Bare tubes of radium (small doses of radium unscreened except for glass container, and therefore localized and caustic in action)

[1] Dr. Goeller of our staff is responsible for this.

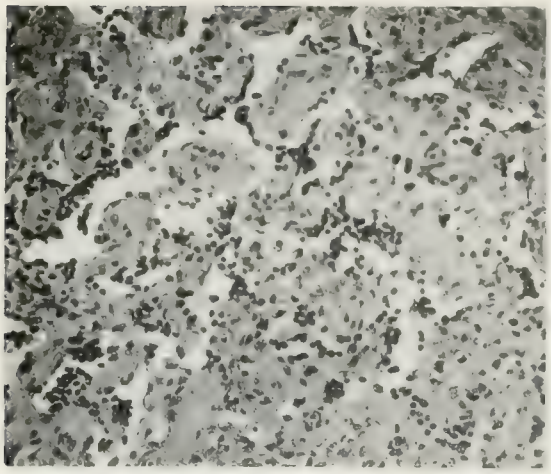

Fig. 3. Radium changes in epidermoid carcinoma of bladder. Carcinomatous cell groups breaking up.

have been used both in the prostate and in any extension beyond the prostate, but have proved not as efficient as the "needle method," and are more painful.

4. *Urethral.* The use of radium in the prostatic urethra has been limited to cases in which carcinoma has directly invaded the urethra. Tubes of screened radium (rubber, 1 millimeter; silver, 0.6 millimeters) 2 centimeters long are attached to a linen thread and inserted into the bladder through the sheath of a urethroscope. The urethroscope is removed and the tubes pulled out into the prostatic urethra by the attached thread. When the treatment is finished the tubes are pulled out of the urethra. Two hundred millicurie hours is a maximum dose. This may be varied by using the silver tube of radium in the end of a urethral catheter.

5. *Rectal.* We have treated but a few cases with screened radium in the rectum. This method does not seem to be as efficient as the "needle method" and produces more pain.

6. *Residual urine.* In most cases the residual urine can be prevented from increasing and in a few it can be decreased by the "needle method" of radium treatment.

If this has no effect and the presence of residual urine causes alarming or intolerable symptoms then we resort to—

a. Bare tubes of radium in the bladder neck. A bare tube of radium (6 millicuries) is placed in the end of a flexible needle. This needle by means of a McCarthy urethroscope or Buerger operating cystoscope may be plunged into the prostate at the lower part of the bladder neck. By a plunger the bare tube is pushed out of the needle into the prostate and left there. Its action is local and caustic.

b. If the residual urine does not reduce after this then we resort to the Young punch operation or suprapubic drainage or suprapubic partial prostatectomy.

7. *Pain.* Pain caused by growth of the carcinoma around pelvic or spinal nerve has rarely reacted to radium or X-ray treatment.

8. *Swelling of legs.* This symptom caused by pressure of the carcinoma on the common iliac vein has been successfully combated by the radium pack. This is placed on the abdomen and centered over the vein compressed; from 10,000 to 15,000 millicurie hours are given.

9. *Rectal stricture.* I have had one case in which I inserted bare tubes (2 of 5 millicuries) into one segment of the stricture. They are inserted through the rectum. This procedure relieved the constipation and made unnecessary a colostomy operation.

RESULTS OF RADIUM TREATMENT

Report of 4 cases of 145 which have gone 3 to 5 years after first radium treatment, and have shown regression of the carcinoma

Case 1. C. D., age 59, first seen October 15, 1915. Complained of loss of strength and flesh (some 25 pounds) and night frequency (from 3 to 4 times) for 4 months. He has had pain in right thigh for 5 years. Prostatic examination (with Dr. Keyes) revealed a large, hard, fixed, irregular prostate, each lobe as large as an English walnut. The left lobe was more prominent than the right, and there was but little extension toward the seminal vesicles as far as could be felt. No residual urine. A radium needle of 50 millicuries was placed in each lobe of his prostate for 6 hours, on October 20, 1915.

January 14, 1916, the patient has gained about 10 pounds. Examination of the prostate reveals marked shrinking of the carcinoma. Sixty millicuries of radium (by needle) was placed for 4 hours in each lobe of the prostate.

February 18, did not get up at night to urinate, and had gained 8 pounds. Slight induration at the base of the prostate. Right lateral lobe treated for 8½ hours with a needle of 30 millicuries of radium.

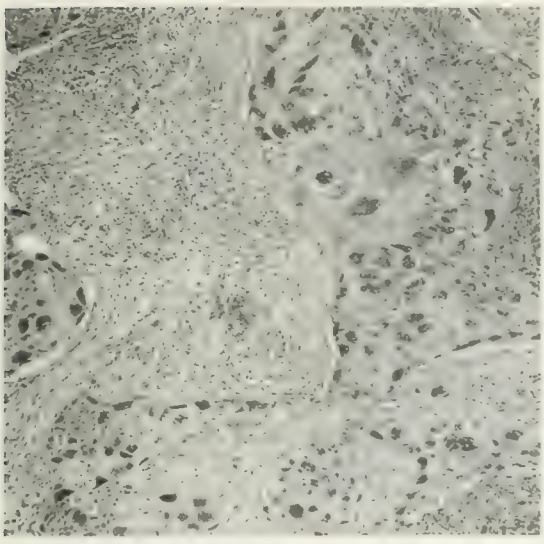

Fig. 4. Epidermoid carcinoma of bladder growing into prostate and clinically giving picture of prostatic carcinoma.

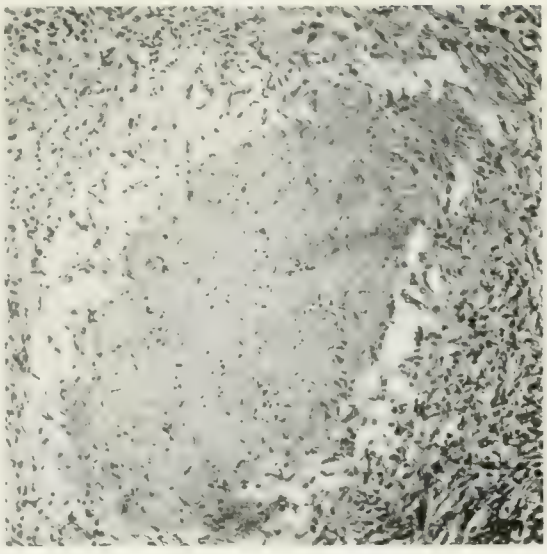

Fig. 5. Radium effect in epidermoid carcinoma of bladder, showing necrosis.

February 27, 1919, up twice at night, working a full day. Weight the same; 64 millicuries of radium in left lobe 6 hours.

November, 1919, up at night, none. Weighs 127 to 130 pounds. Prostate and vesicles feel entirely normal (examination with Dr. Keyes).

January, 1921, 5 years and 3 months after first radium and 2 years and 3 months after last radium, prostate and vesicles normal. Patient in excellent condition.

Case 2. A. S., age 66, first seen October 10, 1916. He had night frequency of urination for 2 years. He now dribbles by night, and urinates every 2 hours by day. Prostate very large, and somewhat irregular but not suggestive of carcinoma. Residual urine, 1,000 cubic centimeters. Cystoscopic examination shows a horse collar prostate. Dr. Keyes did a prostatectomy and Dr. Ewing reported that the specimen showed carcinoma.

November, 1916, the patient had 50 millicuries of radium for 8 hours in what remained of the prostate.

January, 1917, increased frequency for the past three or four days. At night urinates every half hour. Prostate feels slightly lumpy in lateral lobe. He had another treatment of radium at this time.

February 3, patient had retention of urine, and had to be catheterized three times a day. Radium treatment.

February 27, patient had complete retention of urine, and a permanent suprapubic tube was put into his bladder.

June 20, the patient has had severe pain in his prostate in the last 2 months requiring morphine. The examination shows a prostate irregular, scarred, and carcinomatous. The vesicles are indurated and especially the left.

October 15, the patient is in excellent shape physically. He has a collection of calculi around his suprapubic tube. The prostate is flat, the left seminal vesicle has some lumps in it, and is slightly indurated.

January, 1918, radium in left seminal vesicle and prostate.

April, 1918, the patient is in such good shape that I sewed up his suprapubic opening and he left the hospital emptying his bladder.

June, 1919, in the best of shape (examination with Dr. Keyes). There is the same ridge in the left vesicle, the patient empties his bladder, and his prostate feels normal. He is not treated with radium because it is a question if he has any carcinoma left.

January, 1921, 4 years 3 months after first radium and 3 years after last radium, examination the same as in June, 1919. Patient in excellent condition.

Case 3. M. B. P., age 64. In January, 1916, a prostatectomy was done by Dr. Downes at St. Luke's Hospital. The prostate was found on pathological examination to be carcinomatous. His urethra did not stay open after the prostatectomy, the patient beginning to have increasing retention of urine, and his bladder neck was fulgurated in the attempt to keep the prostatic urethra open. He was first seen by me on April 2, 1917. At that time he had a certain amount of residual urine, but I was unable to get a Phillips' whip into his bladder. Prostate was large and soft. Could not feel above it. There was obstruction in the prostatic urethra. The suprapubic wound drains irregularly. He was

treated with 50 millicuries of radium in the right lobe for 6 hours, and was similarly treated in the left lobe.

May 4, urinates twice at night, and can go 5 hours without urinating. Before the radium he urinated every 1 to 2 hours.

June 5, 60 millicuries of radium in the right and left lobes of the prostate, each 6 hours.

October 27, up once at night, and more radium to the right and left lobes of the prostate.

March 1, 1918, 3 weeks ago, 50 millicuries of radium for 7 hours and 15 millicuries of bare tubes imbedded in the right side of the prostate. This burned him considerably, and was probably too large a dose.

August 16, 1919, has a residual of 3 ounces. I get a No. 22 French into his posterior urethra. Suprapubic wound still open at times. Urine is very foul.

December 5, 1919, goes 5 hours without urinating at night. Very small hard lump in left apex of the prostate. Is it carcinoma? He has had no radium for 1 year and 9 months; the rest of the prostate and vesicles show nothing. He is the picture of health (examination with Dr. Keyes and Dr. Mohan).

April, 1921, 4 years after first radium and 3 years and 2 months after last radium condition continues excellent. His suprapubic wound leaks at irregular intervals. Residual ½ to 2 ounces.

Case 4. P. J. H., age 55, first seen July, 1917. Urinary frequency has been present for 3 weeks; by day every hour, by night 6 to 7 times. There is some pain in left groin and testicle and at end of urination. He has lost 10 pounds in weight. Rectal examination shows a not very large prostate, but very hard and irregular carcinoma running into left vesicle (confirmed by Dr. Keyes). Cystoscopy shows an irregular bladder base and irregular bulging of prostate into bladder. Residual none. A steel needle holding 95 millicuries of radium was placed in left prostate for 4 hours. Lost track of until May 7, 1920. (He had during this interval been operated upon for osteomyelitis of skull.) Prostate feels absolutely normal. Both vesicles sclerosed (confirmed by Dr. Keyes). Urinates once at night and five times by day. In excellent health.

May, 1920, bare tubes of radium were placed in the vesicles.

January, 1921, 3 years 5 months after first radium and 1 year after last radium condition remains excellent and same.

In these 4 inoperable cases the prostates and vesicles are somewhat irregular, scarred, but otherwise normal. They are the only cases which have gone a sufficient length of time since their first and last treatments to report. They all show marked regression of the disease.

RESULTS IN TWO CASES IN WHICH THE CARCINOMA WAS CONFINED TO THE PROSTATE AND ONE BORDERLINE CASE OUT OF 145 CASES SEEN

Case 1. J. C., age 70, first seen in February, 1916. He gave a history of urinary frequency, chiefly at night (3 or 4 times) for the past 6 months, then acute retention. Patient has lost about 8 pounds. Rectal examination showed a flat irregular prostate with prominent nodules at prostato-vesicular junction extending into the vesicles. He was treated several times with radium needles through the perineum. He had no more attacks of retention, his general health improved, and his prostate remained soft and irregular but showed nothing to justify treatment.

In December, 1919, the left vesicle seemed slightly enlarged, and radium was recommended as it was feared the growth might be carcinoma. The prostate was flat and soft.

In August, 1920, patient had an attack of severe pain in the back and left side and was confined to bed. I saw him then when he looked near death, was confined to bed with what was probably involvement of his spinal cord by the carcinoma. His prostate felt as normal as in December, 1919.

Case 2. J. A. H., age 61, first seen in August, 1919, with a history of dysuria for 15 months, a small urinary stream, and frequency of urination, and then finally complete retention. He came to the Memorial Hospital from Bellevue Hospital with a retention catheter in his bladder. His prostate was hard, regular, the size of an English walnut. No induration around the seminal vesicles.

On September 5, by means of the cystoscope, a bare tube of radium of 6 millicuries was placed in the median lobe of his prostate.

On September 23, the residual had fallen to 1 ounce, and he got up 2 to 4 times at night to urinate, and at times during the day goes 4 hours without having to urinate. Because of some lumps in his prostate more radium in the form of bare tubes was applied on September 30. Following this treatment he began urinating every half hour by day and night notwithstanding the fact that his residual urine was only half an ounce. He became steadily worse and finally died uræmic. He had chills and fever for a couple of weeks before his death, and his death was probably due to infection from his prostate and to uræmia.

Case 3 (borderline case). J. W. C., age 71, first seen December, 1919, with a history of hæmaturia 9 months previous. Following this he had frequency of urination and urgency. When seen his night urination was 6 to 7 times. Urine has been steadily bloody, for the past 40 days. Residual urine 2 ounces. His prostate was as large as a hen's egg, a hard single lump. No enlargement around the seminal vesicles. He has had 2 treatments of radium needles in prostate. The growth has very markedly gone down. Patient is still under treatment.

SUMMARY

One of these cases is dying of what is probably a metastasis to his spine. Our diagnosis that the carcinoma was confined to the prostate at the time of the first examination was in error. The second patient died uræmic, and the third is still under treatment.

RESULT IN VERY EXTENSIVE CARCINOMA OF THE PROSTATE WITH COMPLETE REGRESSION OF THE CARCINOMA (POSTMORTEM REPORT)

G. T., age 50, first seen at the Memorial Hospital, August 23, 1919. Three weeks ago, partial resection of the bladder for carcinoma was done at another hospital. The carcinoma of the bladder was presumably secondary to a carcinoma of the prostate. When the patient was first seen the prostate was very hard, the size of a tangerine, with a number of very hard nodules in it. The vesicles and the base of the bladder were involved by growth. He came to the hospital with a suprapubic drain. Cystoscopy showed a recurrence at the site of the bladder resection. He was treated with radium and lost track of up to January, 1920.

When seen in January, he had a recurrence in the abdominal incision—3 large lumps, each the size of an English walnut, which were treated with bare tubes of radium.

In January, he was almost exsanguinated because of hæmaturia, and his bladder was again treated with radium.

February, 1920, he had a carcinomatous mass from the symphysis to the anterior superior spine on the right side. On the left side was a mass in the inguinal region 8 centimeters wide from the symphysis midway to Poupart's ligament, an enormous carcinoma of the lower abdomen. This was treated with radium.

In May, 1920, all the abdominal masses had entirely gone and his prostate was markedly shrunken.

In November he went on an auto trip, became chilled, and could not void. An outside doctor tried to pass catheter; 10 days later the patient died.

Postmortem examination showed the following (Dr. Ewing):

"A section from various portions of the bladder, prostate, pelvis, and lumbar lymph nodes failed to show any trace of carcinoma. The walls of the main bladder cavities were everywhere lined with a slough which was very extensive, a diffuse phlegmonous inflammation. The lungs showed purulent bronchitis and pneumonia; the kidney, acute nephritis; prostate, necrosis.

RESULTS IN SUPRAPUBIC PROSTATOTOMY TO RELIEVE RETENTION

This operation has been done in the following way:

Through a suprapubic opening the lower part of the bladder neck has been bitten out with a long rongeur forceps. The operation, aside from using the forceps to bite out the carcinoma, is done precisely in the same way that a suprapubic prostatectomy for adenoma is performed. I have done it only in cases of urinary retention (generally complete) which could not be managed by catheter or which could not be overcome by any of the other described methods. In all cases in which it was done the carcinoma was very advanced. Eight cases in all have been operated upon. Seven cases left the hospital after operation, 1 died in the hospital 2 months postoperative from the growth of the carcinoma around the ureters and failing kidneys. Three were lost track of, after they left the hospital. Two patients went 2 years and 3 months emptying their bladders, and then died. One of these had partial daily incontinence of urine. Wherever practicable the prostate had been thoroughly radiated for a number of months previous to the operation.

RESULTS IN CASES TREATED BY RADIUM NEEDLE IN PROSTATE IN WHICH RESIDUAL URINE HAS NOT VARIED OVER A NUMBER OF YEARS

CASE 1. No residual, October, 1915. Treated by needle in prostate, never any residual to January, 1921.

CASE 2. No residual, but 1 attack of acute retention, February, 1916. Radium needles in prostate, never any residual and no attacks of retention up to August, 1920.

CASE 3. Operation removed carcinoma from bladder neck secondary to prostatic carcinoma, May, 1916. Radium needles in prostate. Up to April, 1919, no residual urine.

CASE 4. Operative removal of carcinoma of prostate, October, 1916. Several acute retentions followed this. Then retention catheter. Radium needles in prostate. From April, 1918, to January, 1921, no residual urine.

CASE 5. Residual 6 to 8 ounces, October, 1917. Radium needles in prostate. April, 1918, residual 1½ ounces. January, 1921, residual again 8 to 10 ounces.

CASE 6. Residual, April, 1917, could not be determined as no instrument could be introduced into bladder. Radium needles in prostate. August, 1918, to January, 1921, residual 1 to 3 ounces. A No. 22 French catheter may be introduced into bladder.

CASE 7. No residual, July, 1917. Radium needle in prostate. No residual, January, 1921.

These are 7 cases out of the first 43 (cases in 1916 and 1917) which are still living, and which have been observed long enough to give an accurate idea as to the effect of radium on maintaining the capacity of the bladder to empty itself. In none of them has the residual urine increased and in 1 (Case 6) it probably has decreased.

RESULTS OF RADIUM (BARE TUBES) IN BLADDER NECK TO REDUCE RESIDUAL URINE

CASE 1. P. D. April, 1918, residual urine 260 cubic centimeters. He had 7 millicuries (bare tubes) of radium, applied in the lower part of bladder neck. In July, 1918, he had no residual urine.

CASE 2. J. A. September 1, complete retention for a number of weeks. Retention catheter September 5. A bare tube of radium 5 millicuries in bladder neck. September 23, residual urine, 1 ounce. October 21, residual urine ½ ounce.

CASE 3. J. C. Complete retention for 2 weeks. Retention catheter. Bare tubes of radium 6½ millicuries in bladder neck. Five days later he emptied his bladder and continued to do so for 6 months.

We have tried this method in 4 other cases with no effect on the residual urine. It is a procedure not without danger, as 1 patient who had an extensive carcinoma of the prostate with foul urine and complete retention died 2 weeks after bare tubes were placed in the bladder neck. He died outside of the hospital.

Before the tubes are applied the patient's bladder should be gotten as clean as possible, and the kidney function determined. He should be in the hospital.

YOUNG PUNCH OPERATION

This has been performed in 4 cases; in 2 without success; in 1 the patient went from a complete retention of urine to 1 to 2 ounces of residual urine, but died 2 weeks after the operation from infection of his kidney. The fourth patient left the hospital emptying his bladder within an ounce. One year later he was heard from, and at that time the suprapubic fistula had reopened so the success of the operation could not be determined.

SUMMARY OF METHODS TO REDUCE RESIDUAL URINE IN CARCINOMA OF THE BLADDER

Sometimes the needle method in the prostate reduces the residual urine; sometimes the bare tube in the bladder neck does this, but this method is accompanied by considerable pain and some danger. Occasionally the Young punch operation works, as does nearly always the major operation—the spurapubic cutting out of the lower part of the bladder neck. The problem is the most difficult one we have to deal with, and the ideal procedure in intractible cases has not yet been found.

RESULTS IN REDUCTION OF SWELLING OF THE LEGS CAUSED BY METASTATIC CARCINOMA

We have had 2 cases in which, by means of a radium pack, the swelling of one or both legs has been reduced. In 1 of these patients who had swelling in one leg, and considerable disability, the swelling reduced 1 month after the radium pack, and the patient lived in comparative comfort until he died of a cerebral thrombosis. In another patient who had swelling of both legs and œdema as far as the umbilicus, the application of 1 radium pack over the right lower abdomen succeeded in reducing the œdema within 1 week after its application. Both of these cases had very extensive carcinoma of the prostate and no attempt was made to treat the carcinoma itself.

CONCLUSIONS

1. In but 2 per cent of cases of carcinoma of the prostate seen at the Memorial Hospital is the carcinoma apparently confined to the prostate.

2. Routine prostatic examination of all patients beyond the age of 50, irrespective of symptoms, is the only rational method whereby we may hope to make a diagnosis of prostatic carcinoma early in the disease.

3. The results of radium treatment of carcinoma of the prostate are superior to operative removal both in causing regression of the disease and in coping with urinary retention.

MEDICAL EDUCATION[1]

By JOHN B. DEAVER, M.D., F.A.C.S., Philadelphia

SCARCELY a decade ago the American College of Surgeons was conceived and brought forth to the light of day. Organization in medical circles is no new thing to the profession. Not a few local societies in the United States have celebrated and others will soon celebrate centennial anniversaries of their birth, while some of the national organizations, though not quite so hoary, are sufficiently advanced in years of activity and experience to have achieved a definite and honorable place in the history of American medicine. We therefore make no claim for originality in organizing the surgeons of the country into a national body for the preservation and enhancement of the welfare and the honor of surgery. But the ideals and aspirations that found concrete expression in the formation of this body confer a certain distinction, and in these we claim the confidence and support of the best elements in the profession.

The articles of contract contained in the pledge admitting to membership in the College sufficiently attest the high standards which the College represents. I would stress the point that the taking of this pledge is not merely a matter of lip service, but entails a moral obligation to live up to every iota of its requirements—a responsibility which none may venture to ignore or to shirk.

The influence of the American College of Surgeons is only just beginning to make itself felt. One of its notable achievements has been to discredit the evil of fee-splitting. We have known that at times money changers have gained access to the Temple of Medicine, and we have almost feared to speak of the disgraceful practice that might easily have cost us the respect and confidence of the laity. Singly we were powerless to deal with the offenders, but united in an organization comprising those who scorn illicit practice and secret gains we can proclaim that we are against those whose morals and ethics are so low as to permit the barter and sale of patients or, indeed, any plan of action that does not make the best interest of the patient the paramount consideration. The profession as a whole deserves the trust and confidence that the laity in general accords us, and we do not propose to rest supine until discredit comes upon us by the action of bastard disciples of our art. In line also with the ideal of mutual confidence and trust is the evidence given particularly within the past year of the wider interest of our organization in matters of public health and the education of the laity in the subject of prevention—a word that today assumes such tremendous importance in every phase of life. The report of your secretary general gives in detail the wide range of territory and the wide range of subjects that have been covered during the past year in the public addresses given in connection with meetings of local societies under the auspices of the College. On the few occasions that it has been my privilege to contribute to these public discussions it has been most gratifying to note the intelligent interest aroused among the laity in the subjects presented—an interest that must needs bear results of lasting benefit. Prevention is but the natural evolution of the advances which have come with the increased knowledge of the cause of disease. Preventive medicine in the broader sense includes surgery as well. The public can be educated in essential points in surgery just as in matters of hygiene and sanitation. The intelligent lay mind is exceptionally eager to acquire a knowledge of the mechanism of the human frame and of bodily functions and their disorders. With the acquisition of this knowledge there naturally comes a greater respect for health and a wider recognition of the importance of early attention to the conditions, which, if treated in time, would go a great way toward obviating extensive and expensive surgery, or prolonged medical treatment. If this phase of the work of the American College of Surgeons continues to develop as it should, it may well be said of its founders that "they builded better than they knew."

[1] Read before the Clinical Congress of American College of Surgeons, Philadelphia, October 28, 1921.

The recent announcement of the College of the establishment of a Department for Literary Research should interest all who wish to draw upon the vast and rapidly increasing storehouse of medical and surgical literature. Plans are maturing to utilize more fully by statistical means that vast surgical experience of this country much of which now goes to waste so far as its influence upon subsequent practice is concerned.

It is but natural that the voice of the College should also be heard in matters regarding the training of the surgeons of the future. Who better than this College can influence the future course of education in surgery? Who knows better than the surgeon who is in touch with actual conditions, what manner of man is best fitted to deal with the problems of surgery, whether they be those that concern the individual patient or those fundamentals upon which progress depends. We who are doing the world's work must see to it that our influence in this respect is not usurped by those who sit at their desks and think out specious arguments fortified by vast financial power placed at their disposal by well-meaning men who are not themselves qualified to judge in this sphere but must be guided by advisers who are not always infallible. I am thinking of the recent furore in favor of the full-time teacher in clinical branches. I am musing over the creation of great clinicians overnight by the feat of powerful influence. I am impressed by the rapid metamorphosis of the fledgling, nurtured, shielded, not to say mentally confined within the limits of sympathetic institutions and departments. I am not questioning the motives of the originators of this audacious movement, but I am watching for its results, not too brilliant thus far and promising less. I am concerned for the students, and would be alarmed for the profession were it not for my great confidence in the sober sense of that great body of a democracy such as this which will eventually work its way toward its own proper method of dealing safely and sanely with conditions. Still I marvel at that new super-intelligence, which in rapid pursuit of its ideal, sets aside the principle of natural selection, the well-proved motive of human endeavor (high reward) and the cardinal virtue for the attainment of practical results, experience. In my heart I am thankful that such men had no voice in the selection of a generalissimo for the allied armies and I note with curious reflection that the vast resources upon which the idea floats were not obtained and are not conserved by similar fancies.

During the last 5 years as you know the tendency has been toward the full-time clinical teacher. Its central idea was good but its application, begun before the war, if I mistake not, was influenced by the German idea of efficiency, which as all now know, failed utterly to include the human element in its equation. Without wishing to appear reactionary but with the interest of the profession in mind, I do not hesitate to say that I doubt the wisdom of the present course. It is an extreme, and the pendulum must soon swing in the opposite direction. The professor of clinical branches should not only be allowed, he should be obliged to be in direct professional contact with the public. The science and art of surgery are one and inseparable. There can be no art that is not based on science and there is no science without its practical application. Of the chaste union of the two shall spring the fruit of the tree of life for the untold millions born and unborn whose lives and whose happiness shall depend upon sane surgical science and safe surgical skill. Science has been kept sane only by constant contact with observed and demonstrable facts, like the giant who renewed his strength by contact with mother earth. Practice is kept sane and free from the danger of the rule of thumb only by a constant infusion of science. The problem of today is to avoid conflict between these essential elements of a real union, to provide for their proper function, to inculcate into the minds of the young the true conception of their relations and responsibilities, and to deliver to society the greatest good to the greatest number. The last consideration is the most momentous one, for it means results, and it is by results that we shall justly be judged.

We must deplore, therefore, anything which detracts from that high standard of service to the community which the community has a right to demand, in view of the extraordinary

freedom and power which it has conferred upon us. It is our profound belief that the system of full-time salaried chairs for the clinical branches which has been forced upon a number of our foremost institutions by powerful influences, is not only contrary to the spirit of American institutions, and contrary to the proper working of the human mind, but that it is sure to result in degeneration of that art which is the true flower of science, and in the deterioration of the instruction to the student how to deal effectively with the problems which he must confront in his chosen life work. To me the plan smells of the midnight oil of the theorist (to say nothing of the oil which has lubricated the ways for its launching). It has in it none of the red blood of the real administrator working to get results with humanity as God made humanity. In its application as I have witnessed it the plan shows no appreciation of the fact that the head of a clinical chair must be a clinician. Is not the clinical art also a science? Does it not rest upon knowledge and does it not depend upon aptitude, ability, experience, and hard work? Can any one become a clinician by merely calling himself or being called by that name? Does appointment to a professional chair make him a teacher? Or is it no longer true that in addition to knowledge which is not so common a possession, the successful department head must have qualities of personal integrity, stimulating personality, and administrative ability?

In attempting to remedy the evil of the clinical professor overloaded with private practice and neglecting his teaching, his department, and his scientific work, these men of admirable intentions have gone to an equally unjustified extreme. Orderly evolution was going on, even rapidly, if one considers world movements, but it apparently was not rapid enough for those who seek to reach the heights in a bound. But this is the day when the professor may try his theories on the whole human race, and the Pied Piper of Hamelin has his counterpart in Russia and would-be imitators everywhere.

If I mistake not there are signs of returning sanity. The domination of those who have shown their inadequate grasp of the whole problem is being loosened. Let us hope that the education of our youth will be entrusted to men who are outstanding figures in the field which they are presenting to the impressionable mind. Let us all fully realize that science is the beginning of practice and that practice is the goal of science.

CLOSURE OF THE ABDOMEN WITHOUT DRAINAGE AFTER CHOLECYSTECTOMY AND CHOLEDOCHOTOMY[1]

By H. M. RICHTER, M.D., F.A.C.S., Chicago

THE closure of the abdomen without drainage after operations upon the gall bladder and tracts, as an isolated item of surgical technique would have relatively little importance. In the evolution of gall-bladder surgery the earlier workers frequently closed the abdomen usually after the most elaborate preparation of the stump of the cystic duct. Because of resultant unpleasant sequelæ, it became the routine practice of many surgeons to use postoperative drainage. My purpose is to discuss closure of the abdomen without drainage as one phase of a principle involved in treating cases usually drained. Individual practice in closing the abdomen without drainage varies greatly, but there is undoubtedly an ever widening field in abdominal surgery involving infective conditions in which the operation is generally followed by closure. The ability of the peritoneum to protect itself is well known. Yet in the presence of frank peritonitis, and in the management of other conditions less obviously infective, the practice of postoperative drainage is usual. The writer has closed the abdomen without drainage in infective conditions associated with a frankly developed peritonitis wherever he has been able to remove the source of continuous reinfection, except where the peritonitis is far advanced. This list includes particularly acute appendicitis in adults and in children, with free peritonitis, and perforated gastric and duodenal ulcer with the usual widespread peritoneal involvement; it also includes some cases of well-defined abscess formation, but I have more commonly drained such localized infections.

There has been no death among the cases of appendicitis so treated, which includes 50 cases in children under 13 years of age. In 20 consecutive cases of perforated gastric and duodenal ulcer closed without drainage, one moribund patient died within 6 hours after operation; one died 5 weeks later from subphrenic abscess.

Operations upon the biliary structures are analogous to gastro-intestinal surgery in that the peritoneal toilet can be quite perfectly completed, and has the advantage over intestinal surgery of dealing with far less infective material. Here, therefore, one may particularly inquire into the need of postoperative drainage.

The various discussions on the subject have brought out many facts and speculations, which taken with my personal experience dating back to my first primary closure after cholecystectomy in June, 1915, suggest the following statement relative to the procedure in gall-tract surgery when definitive closure of the abdomen on the completion of the operation is contemplated.

CHOLECYSTECTOMY

First, the cystic duct should be clamped, cut, and ligated. Very fine catgut is ample for this purpose. The maximum bile tension is far less than the arterial tension of a small vessel, and to double ligate it or to use heavy or unabsorbable material for this purpose is an absurdity. Heavy ligature material partakes of the nature of an objectionable foreign body. (The effect would be about the same as if a laparotomy pad were left in the wound.)

Second, the treatment of the cystic duct is finished when it is ligated. It is safest when left free to be covered over by the adjacent structures. It is illogical to tuck it away behind the peritoneum, and unnecessary to make kinks or peritoneal cuffs or infoldings for its protection. It has never reopened in my experience or in the experimental work of my associate, Dr. Buchbinder.

Third, the raw surface of the liver bed left by the removal of the gall bladder needs no attention other than temporary packing during the remaining steps of the operation to prevent or lessen oozing. Its sides tend to fall together to some extent. Peritonealization is meddlesome and tends to produce an objec-

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tionable dead space for the accumulation of blood and what little bile may exude from its surface. Massive postoperative adhesions are due far more to the foreign body used as drainage material than to the inconspicuous, retracted, raw surface of the liver.

Fourth, bile leakage from the liver surface is of trivial importance. We have never found it except where drainage has been instituted and have never had occasion to reopen the abdomen because of it. The tolerance of the peritoneum to massive bile leakage is very considerable; the effect of what little may leak from its surface can scarcely be of clinical importance.

Fifth, the most persistent criticism we have met has been based on the danger of the cystic duct reopening after closure of the abdomen. The basis for this criticism is that when drainage material is placed in contact with the ligated cystic duct, the duct not infrequently opens up with profuse leakage of bile. "What would happen," asks the critic, "if the drain had not enabled the leaking bile to reach the surface?"

The criticism is based on false premises. Were one to place a drain down to the line of suture of a resected bowel, reopening and fistulæ would be frequent. I have had one such fistula in thirty consecutive gastric and duodenal perforations that I have sutured; it was the only one of the series in which I placed a drain down to the suture line. The lesson is obvious. It is the drainage material which causes the bile leakage. It prevents the primary union which is the insurance against leakage.

Sixth, it is not possible to close all cases. In the presence of persistent oozing from the liver surface, gauze packing is necessary. In the presence of jaundice such a pack may be a wise prophylactic measure, though cholecystectomy is rarely indicated when jaundice is present. Unusually active infection or actual suppuration outside of the gall-bladder may make drainage necessary. We have drained or packed 12 per cent of our recent cholecystectomies.

Seventh, the omission of drainage seems materially to lessen the postoperative discomfort of the patient. The immediate convalescence is unusually smooth. Patients are encouraged but not urged to leave their beds early, yet the average stay in bed has been but 5 days. There has been no hernia in the series.

CHOLEDOCHOTOMY

Where the common duct can be sutured and closed without drainage the advantages are exactly analogous to those of cholecystectomy. The maximum bile tension within the common duct is not comparable with the sustaining power of a line of fine catgut sutures. Its contents are not nearly so infective as those of the intestine. Its peritoneal coat must always be included in the line of suture, for the peritoneum is, of course, the one great barrier against infection. In default of peritoneum I have tacked the omentum down to its sutured surface, a step which is also of value in lessening adhesions, after the suggestion of E. Wyllys Andrews. But so sutured, the analogy to the intestine is complete, and drainage material placed in contact with it is as illogical as in the case of resected bowel.

To suture the common duct and close the abdomen with safety presupposes:

First, that its peritoneal coat is not so destroyed in the operative maneuvers as to render it useless.

Second, that the suture material and needles are of the finest size.

Third, that no stones are left behind or stricture overlooked.

Fourth, that the diameter of the duct is sufficient to permit of two lines of suture, with ample room to permit of the traumatic swelling that is to be anticipated.

Fifth, that the walls of the duct are not too infiltrated or rigid to permit of free manipulation.

The abdomen should not be closed in duct cases in the presence of jaundice, or acute infection, although we suture the duct in nearly all cases. Suture of the duct returns to it its normal function of a drainage tube. As such it functionates perfectly, carrying the bile to its normal place in the bowel. The percentage of cases in which the abdomen can be closed with safety is probably smaller than after cholecystectomy. We closed ten out of our first eleven consecutive cases when we began

omitting drainage, with no postoperative accident, but we have had two deaths since, in 19 cases. One patient was highly jaundiced at the time, and should not have had the extensive operation to which he was subjected. The other patient had a pernicious vomiting persisting for several weeks before operation, associated with jaundice. She had had a cholecystectomy at another hospital some 8 weeks before and the vomiting had begun soon after. Exploration revealed a stone in the ampulla, as the only lesion apparent. The vomiting persisted without intermission until death, without its cause being discovered. Neither patient showed any evidence of postoperative peritoneal damage. Both cases required transduodenal opening of the ampulla to release an imparted stone. Both patients were jaundiced, a condition that is not compatible with extensive surgical interference. Preliminary common duct drainage is strongly indicated in such cases, as suggested by Crile.

Is the method rational? If the method is rational it is permissible to attempt it, otherwise it would be impossible to inaugurate new methods in surgical technique. I have discussed the logic of the closure of the abdomen after gall-bladder and gall-tract operations. It is the same logic that holds good in gastrointestinal surgery.

OPERATIVE MORTALITY

Mortality statistics that are not explanatory are misleading. This is particularly true of a small series of cases, where a death or two multiplies the death rate.

There have been two deaths among over 100 cholecystectomies performed by my associates and myself, and neither case had any suggestion of abdominal complications. One was a case of cirrhosis of the liver with an obliterating peritonitis and an associated nephritis. The operation was exploratory and a pathological gall-bladder was incidentally removed. The patient went into coma some hours later. The second death occurred after several days of a frank pneumonia. There were no abdominal symptoms. Neither death could have a bearing on the particular phase of gall-bladder surgery that we are as present discussing.

Drainage of the peritoneal cavity is far too frequent a procedure. The removal of the source of infection, whether appendix, perforated ulcer or gall-tract lesion, preventing further continuous infection of the peritoneum, almost always justifies its closure without drainage, except in advanced peritoneal destruction or localized abscess formation. With the removal of the source of infection the residual infective material can usually be more safely disposed of by the closed peritoneum than by one whose defensive power is inhibited by the presence of a foreign body in the form of a drain.

In the great majority of gall-tract cases, no considerable infection is present. In the chronic cases it is usually difficult or impossible to demonstrate any organisms. In the acute cases mechanical factors play a large part in the fulminant character of attack, while in the frankly infective cases it is remarkable how few organisms are found outside the gall tracts. Bacteria within the gall tracts have no bearing any more than in the surgery of the bowel.

I have no hesitation in advocating closure after cholecystectomy in suitable cases. Following the work and publications of A. Murat Willis of Richmond, Virginia, the method has been taken up in various clinics and enough experience has accumulated to justify expectations of its permanency.

I offer the suggestion of closure after duct operations with far greater diffidence and some fear. Undoubtedly greater technical dexterity is required. The exposure of the field of operation must be adequate. The peritoneum must be preserved. Rope-like suture material will cut through the tissues like a Gigli wire saw and permit bile leakage. But with proper preparation and painstaking efforts, the technical difficulties will not prove insurmountable, and my personal experience suggests unusually satisfactory results.

RELATIVE MERITS OF "IDEAL CHOLECYSTOTOMY," CHOLECYSTECTOMY, AND CHOLECYSTOSTOMY[1]

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IN order to simplify the discussion of the relative merits of these procedures, we may place our gall-bladder cases in two broad groups. The first group comprises those patients who are acutely ill, and those in whom severe pathology has existed for some time. These patients are frequently elderly; often they are excessively fat; there may be cardiac, renal, and hepatic damage; and, not infrequently, an obstructive jaundice is present. Upon opening the abdomen, there is plain evidence of disease of the gall bladder. Theoretically, such cases clearly present the indication for cholecystectomy. The gall bladder is grossly diseased and it seems scarcely justifiable to hope that it will ever again resume its normal function. As a matter of fact, however, experience shows that it is precisely in these cases that cholecystectomy sometimes proves disastrous, while surprisingly good results may be obtained by cholecystostomy and the institution of drainage. There is no question but that cholecystectomy is a more difficult and dangerous operation than cholecystostomy. Unquestionably, a second operation is necessary more frequently after the latter, but the opportunity to do a secondary operation is sometimes a source of satisfaction. It must also be admitted that the necessity for a secondary operation does occasionally arise after cholecystectomy. It is necessary only to mention the incomparably greater difficulty of exploration of the ducts in the absence of the gall bladder. In addition, it is, indeed, surprising to what an extent the apparently hopelessly involved gall bladder will recover at least a part of its functional ability following cholecystostomy. I have shown elsewhere that the presence of a bile-soaked drain in the peritoneal cavity excites the production of dense adhesions. However, patients who have suffered from severe gastric distress; from acute agonizing colic; from recurring exacerbations of an infectious process, by the relative relief obtained following this surgical procedure will disregard the minor discomfort which may arise from the additional adhesions.

Granting that many of these cases of marked involvement of the gall bladder will be more benefited by the conservative operation of cholecystostomy than by the more radical cholecystectomy, at first consideration, it would seem that cholecystostomy is even more definitely indicated in the second group of cases. In this group may be placed those patients who have suffered with vague but suggestive symptoms for a comparatively short time; and those in whom the local changes are relatively slight; and where there is little damage to their vital organs. With every refinement of diagnostic aid, it is often impossible to make a positive diagnosis of gall-bladder involvement before the abdomen is opened, and, indeed, even after exposure of the gall bladder, not seldom we are unable to determine positively whether the organ is the seat of a pathological process. I have, on previous occasions, stated that a source of humiliation to me existed in the fact that I have seen some surgeons unhesitatingly pronounce diseased and remove a gall bladder, which to me seemed normal. Since, therefore, in the patients of this group there is often only slight or no involvement of the gall bladder, would it not seem best to perform the conservative cholecystostomy? Attractive as the reasoning appears, I have become convinced that cholecystostomy will prove disappointing in the majority of these patients. The discomfort and impairment of function before operation has been slight; the institution of drainage after cholecystostomy produces the characteristic dense adhesions which subsequently may produce very definitely greater discomfort and functional impairment than existed before operation. So impressed have we been by the poor results following the performance of cholecystostomy in this type of patient, that we had come to the conclusion

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that if any operative procedure was to be undertaken it should consist in removal of the gall bladder and complete closure of the abdomen without drainage. By this omission of drainage, we escape the dreaded adhesion formation largely or entirely, and that the omission may be safely practiced in the absence of obvious contra-indications seems to have been amply proved by our experience and that of other surgeons.

There seems to be little doubt but that normally the gall bladder has very definite functions, two of these being the storage and the concentration of the bile. It has been stated that patients show no bad results after removal of the gall bladder, but it would seem actually impossible to assert this positively with the evidence that we possess. We may know that they are relieved of their pressing discomfort; that they are able to perform the ordinary tasks exacted of them, but we do not know that there is not some obscure disturbance of function. If the need is sufficiently great, this consideration should not deter us from taking such a step; the ophthalmologist often removes a diseased eye in order to save the other eye; a leg or arm traumatized beyond hope of recovery is amputated without hesitation. But, on the other hand, if the disease of the eye is trivial or the injury to the limb slight, are we justified in adopting the radical measures mentioned? I am inclined to take a similar attitude in regard to the gall bladder. If we are called upon to treat surgically a patient with calculi in the gall bladder but with no indication of infection, are we justified in performing either of the ordinary operations, cholecystostomy with drainage or cholecystectomy? If we practice the former, our patient will, in all likelihood, suffer more severe symptoms after the operation than he did prior to seeking surgical aid; if we remove the gall bladder, we are forced to the admission that we have sacrificed an organ which performs definite functions and the removal of which may result in disturbance of the bodily functions.

For some time, I have felt that there should be a suitable middle course that might be followed in many of the cases of slight or early involvement of the gall bladder. This procedure, like the omission of drainage after cholecystectomy or after opening the common duct is not new; indeed, it is none other than the "ideal cholecystotomy" practiced and abandoned many years ago. I do not believe, however, that the abandonment of the operation is any proof of its uselessness. In the early days of gall-bladder surgery, diagnosis was much more uncertain and unreliable, and surgery of the gall bladder was largely confined to the first group of cases here described. The surgeons had not the requisite amount of experience in this field to enable them to exercise the proper judgment in the selection of cases suitable for the operation. Even now, with the vastly improved technique, the performance of the "ideal cholecystotomy" on improperly selected cases will result in failure.

With the improvements that have been made in diagnosis and operative technique, there are certain cases where the "ideal operation" seems indicated: first, in those patients where it is impossible to make a positive diagnosis of gall-bladder disease. There may be a history strongly suggestive of a mild infection, but on exposing the gall bladder, there are none of the signs which indicate beyond a question of a doubt that disease exists. Are we justified in removing such a gall bladder? On the other hand, if drainage be instituted there will inevitably result the formation of those crippling adhesions which may render the patient more of an invalid than he was before operation.

Although I am thoroughly cognizant of the popular expression, "innocent gall stones, innocent doctor," there is next recognized as an indication for the "ideal cholecystotomy" those cases of "silent" stone of which, in my opinion, there are many. They are frequently discovered during the course of an operation for some other disease, or in the routine X-ray study of the gastro-intestinal tract. Most careful inquiry will often fail to elicit any history of gall-bladder disturbance, or there may be obtained a story of mild recurring attacks of epigastric distress. These calculi acting as foreign bodies may be potential causes of recurring infection or of biliary colic, but scarcely justify the removal of the gall bladder or the performance of the even more injurious cholecystostomy.

In summarizing, it may be stated that cholecystostomy and drainage is a procedure of great value in certain instances, but its use in unsuitable cases leads to frequent disappointment; likewise cholecystectomy is an operation of great value in many instances, but the trend toward removal of every gall bladder capable of removal will inevitably result in the sacrifice of many functionally valuable organs, the invalidism of a certain number of patients from injury to the bile ducts, and the premature death of others.

My advocacy of the "ideal" operation in some of these cases is not based solely on theoretical considerations. I have already practiced this procedure in a limited number, and the results obtained have been most gratifying and encourage me in my belief that this operation has a definite field of usefulness in the surgery of the gall bladder.

THYROTOXICOSIS[1]

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THIS paper is limited to a brief discussion of the diagnosis and treatment of thyrotoxicosis, with some figures derived from clinical and autopsy study at the Mayo Clinic and here and not previously published. We will only mention the developmental anomalies, myxœdema, colloid goiter, adolescent goiter, and malignant disease, since these usually offer no great diagnostic or therapeutic difficulty if we have them in mind when examining the patient.

The physical examination of the thyroid is worth description. The patient's head should be forward and down to relax the neck muscles; and palpation undertaken by pushing the trachea and thyroid to the side with the fingers of one hand and palpation done between the fingers and thumb of the other hand. By this method one can nearly always outline the normal thyroid. In many clinics I have seen the patient's head put back and thyroid enlargement estimated by palpating the isthmus and by seeing and feeling the fullness on the sides, which method is responsible for the phrase often seen in records of physical examination: "The patient has a palpable thyroid." The thyroid should be palpable in nearly every normal individual.

ADENOMATA

Adenomata of the thyroid fall under two clinical classifications: non-toxic and toxic. These divisions are purely clinical, since no histological difference has been demonstrated and they shade into one another to such a degree that certain cases may be differently classified by equally competent observers. Such confusion is now less marked since the introduction of basal metabolism determinations.

The adenoma appears first as a small tumor, palpable in the thyroid, and may grow so slowly that years elapse before its discovery by the patient. It is occasionally found in children and is usually discovered before the patient reaches the age of 30. It may be present in an adolescent goiter and only discoverable after the adolescent goiter has subsided. There are no early symptoms, unless due to pressure. Slow growth may continue for years, and large size may be attained with remarkably little mechanical inconvenience to the patient. Adenomatous growth may become stationary at any time, and after years it may again show growth. Rarely, an adenoma slips through the thoracic strait and grows downward, following the path of least resistance, and giving rise to the marked mechanical and toxic symptoms of substernal goiter.

It is an unsettled question whether all adenomata eventually become toxic. The more these cases are studied, however, the more convincing is the evidence that every adenoma becomes toxic sooner or later; and that the lack, or severity, of symptoms is only

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an expression of the patient's resistance to the toxicity of that particular goiter. Certain adenomata apparently produce no symptoms after many years, because the amount of toxæmia is too small to affect the particular host, whereas the same amount of toxæmia might cause much trouble in a less resistant host. We may find a slow poisoning like that typical of chronic alcoholism; no symptoms for years in spite of continued dosage and then a relatively sudden and complete breakdown of nervous, cardiorenal and metabolic centers. Calorimetric study shows that the metabolic rate is high long before any symptoms are evident to the patient; in other words, the onset of toxic symptoms is very late evidence of long-standing chronic intoxication.

Symptoms. The symptoms of adenomatous thyrotoxicosis are nervousness, tachycardia and cardiac insufficiency, and loss of weight and strength with vasomotor phenomena. The onset is usually very gradual, although it is often considered by the patient to be sudden. It frequently follows misdirected efforts at reducing the goiter by iodine or by thyroid medication. The characteristic course of the disease is steadily downward without marked exacerbations and remissions. Heart damage is frequently the most pronounced evidence of disease when the patient comes to the physician. Adenomatous intoxication never produces true exophthalmos, although the Stellwag sign so often seen is frequently called exophthalmos.

Treatment. The treatment for the thyrotoxic adenoma is immediate surgical removal if the patient's general condition is reasonably good. If extensive cardiac damage or severe toxicity is evident, then rest and heart tonics should be insisted upon before thyroidectomy. Ligation is unnecessary and ineffectual in adenomatous intoxication.

The metabolic rate drops almost immediately to normal after removal of a toxic adenoma, and bad cardiac damage will often then recover to such extent as to make a reasonably good heart out of an extremely poor one.

The age incidence at operation for "simple goiter" has been charted, showing the ages by decades, of 4,720 cases operated upon: up to 10 years, 5 cases; 10 to 19 years, 239; 20 to 29 years, 991; 30 to 39 years, 1,324; 40 to 49 years, 1,232; 50 to 59 years, 750; 60 to 69 years, 169; over 70 years, 10.

Thirty-one died following operation and twenty-eight of these came to autopsy.

Autopsy in 28 cases showed that four young patients, two aged 19 and two aged 21, had very large thymus glands. Of the remaining 24 cases, all over 35 years old, two showed very large thymi and the others no thymic tissue. The hearts of 22 of the 24 toxic cases evidenced moderate to extreme cardiac damage.

Clinical study of the 31 case histories showed four deaths among the young nontoxic patients. Their goiters had been noted for an average of 3 years. Ten toxic cases had recognized their goiters an average of 32 years, but the histories are not complete enough to give the average duration of their toxic symptoms. Seventeen cases had goiters an average of 28 years and toxic symptoms for an average of 4½ years. All toxic adenomata were in patients beyond 35. Two were under 40, 7 between 40 and 50, and the other 20 were above 50.

EXOPHTHALMIC GOITER

Exophthalmic goiter is the best-recognized type of thyroid intoxication. It is always associated with a diffuse parenchymatous hyperplasia of the thyroid. Certain other changes have been described in the ductless glands and some observers feel that the thyroid hyperplasia is but one manifestation of a generalized disease, rather than the cause of it. The symptoms are, however, definitely relieved by removal of a large part of the thyroid; therefore, we may from a practical standpoint regard the thyroid as the cause of exophthalmic goiter.

The course of exophthalmic goiter is very typical. The now well-known work of Plummer has shown that at an average of 9 months from the onset there is an explosion of symptoms that prostrates more or less completely, and gastro-intestinal symptoms often develop at this time. The crisis reaches a climax and then improvement sets in, if the patient does not die. After improvement the patient

has ups and downs until an average of 2 years from onset when there is a second crisis; the second crisis is not so severe from the standpoint of toxicity, and patients rarely die at this time. The cardiac condition is, however, much worse. The average cardiac dilatation during the first crisis is half an inch and at the second crisis is one and a half inches. Recovery being the rule, the patient gets better again, but is often left with a very bad heart. Ups and downs of reasonable health are resumed, with little exacerbations of trouble, over a period of from 3 up to 8 or 10 years, when gradually the hyperplasia of the thyroid, and the symptoms, play out. The end-result may be complete symptomatic recovery, but only too often the end-result is a patient without active intoxication; but a wreck from chronic cardiorenal and hepatic degenerations.

Symptoms. Symptomatically the disease produces typically goiter, exophthalmos, tachycardia, tremor, and loss of weight. Certain other features are fairly constantly seen. A large proportion of cases show a thrill and bruit over the thyroid vessels which is almost pathognomonic. Weakness in the quadriceps muscles is often most pronounced; in fact the patient's weakness is sometimes first evidenced by her falling down, because of weakness in the knees, and then being unable to rise unassisted—inability to step upon a 12-inch stool or to rise from a chair without assistance is very characteristic. Vasomotor phenomena are common, particularly sweating, a sense of subjective heat, and flushes. Acute gastrointestinal disturbances occur and indicate very severe toxæmia. Acute vomiting and diarrhœa are definite contra-indications to immediate surgery. A late type of chronic diarrhœa is seen which is not of such serious import from the standpoint of operative risk, because due to chronic cardiac, hepatic, or pancreatic degenerations. Acute abdominal pain may rarely be seen in an exacerbation of toxæmia. I have seen one case of exophthalmic goiter suffering from severe abdominal pain, have a normal appendix removed. A big appetite associated with loss in weight, is practically only seen with exophthalmic goiter or diabetes. Bronzing of the skin occurs in older people, so marked sometimes as to suggest Addison's disease; it is considered due to adrenal disturbance. Generalized pruritus, without apparent skin lesion, is seen. Glycosuria is always mentioned in exophthalmic goiter symptomatology. In my experience it is no more frequent than in any other disease.

Treatment. The treatment of exophthalmic goiter is essentially surgical. The internist has his place in the diagnosis of the disease, and in supportive treatment frequently indicated before and after operation. Rest is definitely indicated to reduce the metabolic rate, and plays a large part in treatment. Rest for a reasonable period under observation should always precede operation, in order to determine the general condition of the patient, and the stage of the disease.

Cardiac insufficiency is treated by rest and digitalis medication. It is wonderful to see an auricular fibrillation due to exophthalmic goiter quiet down and then see the patient go through surgical interference with little trouble.

Postoperative medical care is seldom mentioned in connection with exophthalmic goiter, and often bad results are seen from failure to give it. Without going into theoretical discussion as to whether this disease is due to excessive or disordered thyroid secretion, certain facts are evident. The surgeon removes two-thirds or more of the thyroid, but he leaves in one-third or less; this part of the gland is definitely as abnormal as the part removed; therefore we may expect and often see little exacerbations of symptoms after operation and in about 10 per cent of cases secondary operations have been necessary. As a working hypothesis we may assume that the operation cuts down the amount of the toxin in direct ratio to the portion of the gland removed, but there is still trouble present and our little postoperative exacerbations are one-third to one-fifth as severe as if the whole gland were in. Marine has shown that very minute doses of iodine seem to assist in the retrogression of the goiter.

After years of exophthalmic goiter, there is sometimes a metabolic rate lower than normal and then small doses of thyroid help.

The age incidence of patients coming to operation for exophthalmic goiter has also been charted, showing the age by decades in 2,645 cases: under 10 years, 7 cases; 10 to 19 years, 263; 20 to 29 years, 823; 30 to 39 years, 814; 40 to 49 years, 551; 50 to 59 years, 168; 60 to 69 years, 19.

While these cases were under clinical observation there were 23 who died without surgical interference and 19 of them came to autopsy. It is interesting to note that not a medical death occurred during the decade between 30 and 40, when the average incidence of the disease is at its highest.

There were 92 deaths following operative procedures and 67 of these came to autopsy, a total of 115 deaths with 86 autopsies.

These 86 autopsies were carefully studied from the standpoint of the thyroid, thymus, lungs, heart, and kidneys and adrenals.

The adrenals showed no constantly discoverable changes.

The lungs showed no active tubercular lesion, although old tubercular scars were noted in 12 cases, a fact of great interest since early stages of pulmonary tuberculosis may resemble exophthalmic goiter so closely as to cause confusion. Numerous articles occur in the literature describing thyroid stimulation as occurring in tuberculosis. I have never seen a clinically active tubercular infection in an exophthalmic goiter patient.

The hearts of patients dying early in the course of the disease showed no definite pathology, but cases of long standing showed regularly chronic myocardial changes and often great hypertrophy and dilatation. The hearts of older patients apparently have a much weaker resistance to the toxæmia.

The thymus was present, and often very large, in every patient dying under 40 years old and was absent in one-third of those over 40 years old.

A clinical study of 115 histories of patients dying with exophthalmic goiter may give us a clue to the average duration of the disease. No figures have ever been attempted on this point, but the loose statement is often made that the intoxication exists for a number of years. We have divided into two classes the 115 deaths from exophthalmic goiter: first, averaging those whose death occurred in less than 1 year from onset, and second, those who lived longer than a year. Fifty-seven cases died within a year, averaging 8 months from first symptoms; and 45 cases died after more than a year of the disease, averaging 6 years from first symptoms. Of the purely medical cases, 13 died within the first year, averaging 6 months of the disease; and 6 cases died after more than a year, averaging 5¾ years of the disease. Only 7 of the 115 cases survived more than 6 years of the disease.

SUMMARY

In summarizing this study of goiter intoxication two points seem evident enough to emphasize particularly:

1. The importance of early diagnosis in order to obtain a cure by surgical removal of a toxic goiter before permanent damage is done the patient. The mortality from removal of non-toxic or mildly toxic cases is almost zero in competent hands, and the net results as satisfactory as can be desired.

2. A badly damaged heart from goiter intoxication does not contra-indicate surgery. Practically speaking the cardiac reserve of the patient is nearly always good enough, or can be improved by treatment until good enough, to withstand operation. The bulk of surgical mortality occurs in the badly toxic cases, not in the extreme cardiopaths. I do not remember ever having finally advised against thyroidectomy because of a bad heart, although I have repeatedly undertaken medical treatment for weeks or months before feeling the patient good enough for operation. The postoperative course has shown such remarkable relative cures of cardiac insufficiency as to more than justify the risks undertaken.

HISTOLOGY AND MORTALITY IN CASES OF TUMOR OF THE BLADDER

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FROM January, 1910, to January, 1920, 333 tumors of the bladder were treated by surgery at the Mayo Clinic. Complete data were obtainable in 262 cases, 216 of which were operable and 36 inoperable.

The mortality in cases of tumor of the bladder depends primarily on the type of the tumor, whether or not it is benign, or if malignant, the degree of malignancy. The location and size of the tumor are next in importance; if it is in an accessible area it may be removed completely, making a permanent cure possible. The age of the patient is also important; young adults stand the shock of operation well, but they often have extensive growths of a high degree of malignancy. In infants and in persons more than 60 years of age the operative mortality is very high.

One hundred four (48.2 per cent) of the group of 216 patients from whom the tumors had been removed completely are alive, an average of 3.2 years after operation; 112 (51.8 per cent) are dead, an average of 8 months after operation.

The postoperative data concerning 186 of the 216 patients were correlated with the pathological data, in an endeavor to determine the mortality rate accompanying the various types of growth.

PAPILLOMA AND EPITHELIOMA

One hundred sixty-eight of the neoplasms originated in the normal bladder mucosa. Seventy-four were papillomata, 71 malignant and 3 benign. Ninety-one were either solid epitheliomata or carcinomata.

It is rarely necessary to remove benign epithelial tumors by surgical measures; the majority respond readily to intravesical fulguration. Occasionally, owing to obstruction, infection, or intolerance to manipulation of the bladder, it is necessary to perform an open operation. These papillomata have a definite and in most cases readily recognizable histological picture (Fig. 1). They are rarely more than 2 or 3 centimeters in diameter. The growth of malignant papillomata is limited only by the capacity of the bladder. They retain their pedicle and are composed of clubbed fronds with a marked irregularity of outline. The free wavy arborescence of the benign tumor is often lost and fusion of adjacent fronds is common. Often a number of villi are matted together and the papillary arrangement is completely obliterated. In some areas the cells retain the regularity of the benign papilloma; in others they are undergoing various stages of alteration with marked variation in size, type, and staining qualities (Figs. 2, 3, 4, and 5).

Solid tumors are of two types: the widespread papillary epithelioma, and the low, flat, infiltrating carcinoma. The former has a rolled-out advancing border, the upper surface often being covered with short, stubby, papillomatous protrusions, or the top may have sloughed off, leaving a flat, ulcerated surface. These tumors, sometimes firm, are often soft, flabby, and friable, and can easily be scraped off the surface of the bladder. The histological picture shows the relation of this tumor to the papilloma; remnants of the central connective-tissue axis of alterated papillæ are quite common and occasionally rounded ends of fairly normal villi are seen. In the infiltrating type the margins slope outward to meet the mucosa and burrow down into the wall of the bladder. These tumors are generally firm and compact, and without a tendency to split in cleavage planes. The only difference in the histology of the solid tumors is that most of the infiltrating tumors show none of the remnants of papilloma commonly seen in papillary carcinoma. The individual cells of the two types are practically the same. They vary markedly in size and shape; at times they are enormous with large nuclei containing one or several very prominent nucleoli. These large cells generally take the stain lightly in contrast to

the deep staining of the smaller more compact cells. The form or arrangement is not definite; the cells are crowded together with only a small amount of intervening connective-tissue stroma. Giant tumor cells and large atypical mitotic figures are quite common. Many large thin-walled blood vessels are seen, the walls of which are often indented by buds of carcinoma cells (Figs. 6 and 7).

In all of the 168 cases the tumors were removed surgically. Two of the three patients who had benign papillomata are alive 6 years after operation; one is alive 4 years after operation. Twenty-six (36.6 per cent) of the 71 patients with malignant papilloma are dead after an average duration of life of 11.5 months. The 45 (43.4 per cent) living patients have lived an average of 2 years and 3 months.

Sixty-seven (71.2 per cent) of the 94 patients with solid carcinoma are dead after an average duration of life of 7.5 months. The 27 living patients have lived an average of 3 years and 3 months.

LENGTH OF LIFE OF PATIENTS WITH MALIGNANT PAPILLOMATA

Patients dead		Patients living	
First month	0	After 6 months	7
Two months	1	After one year (3 with recurrence)	10
Six months	6	After 3 years	9
One year	4	After 5 years	10
Two years	3	After 9 years	3
Four years	3		
Total	26	Total	45

LENGTH OF LIFE OF PATIENTS WITH SOLID CARCINOMA

Patients dead		Patients living	
First month	10	After 6 months (3 with recurrence)	4
Three months	2	After 1 year (5 with recurrence)	13
Six months	24	After 3 years	6
One year	14	After 5 years	2
Three years	7	After 7 years	2
Five years	1		
Total	67	Total	27

Twenty (76.9 per cent) of the 26 patients who died from malignant papilloma died the first year after operation. Fifty-nine (88.0 per cent) of the 67 who died from solid carcinoma died the first year after operation. If patients survive the first year with either type of malignancy, they have a good chance for ultimate cure. Thirty-one of the 48 living patients, 41.9 per cent of the total number with malignant papilloma, have lived more than 3 years, while only 10 of 12 living patients, 10.6 per cent of the total number with solid carcinoma, have lived more than 3 years. In the infiltrating type of carcinoma in this group the operative mortality was somewhat higher than in the papillary type. Twenty per cent of patients operated on for infiltrating carcinoma died during the first month, in contrast to 12 per cent following operations for papillary carcinoma. The rarer tumors are discussed by types.

SQUAMOUS-CELL CARCINOMA

Squamous-cell carcinomata are distinct individual types of epithelial growths. Their onset is insidious, their growth is rapid, and they cause few distinctive symptoms. They probably develop from metaplastic bladder mucosa which has undergone epidermization as a result of irritation from infection or formation of stones. The tissue in most cases is firm and friable. The growths involve the wall of the bladder extensively, and are flat and frequently ulcerated; the lateral margins slope out toward the mucosa, sinking deep into the underlying tissues. Sometimes patches of leukoplakia, giving a clue to the origin of the malignancy, are found in the region of the tumor. Squamous-cell growths are most often found in early middle life and are not uncommonly preceded by evidence of long standing cystitis. Compared with other epithelial tumors, these growths occur relatively more often in females. While metastasis is not uncommon, death in most instances is due to the obstruction and infection resulting from the local lesion. The histological examination generally shows a marked cellular activity (Figs. 8, 9, and 10). The cells are large and irregular; they stain deeply and contain many atypical mitotic figures. In some tumors extreme hyalinization and pearly body formation are found, indicating a long standing, possibly premalignant stage. These tumors are the most malignant of the epithelial growths of the bladder. The tumor projects rapidly and

extensively into the deeper tissues; in the region of the advancing border, finger-like extensions are seen separating the underlying muscle bundles.

Geraghty holds that squamous-cell carcinomata are extremely rare; he found only 1 in his series of 180 cases of tumors of the bladder. Albarran found 4 in 125 cases of vesical tumors; 3 of his patients died shortly after operation.

In the series of 262 cases there were six squamous-cell carcinomata; 3 were seen in an operable stage and are included in the classification of solid carcinomata. The average pre-operative duration of symptoms in the 3 cases was only 3 months; one patient had a recurrence 4 months after operation, and died 8 months later; one died 6 months after operation, and the third patient is living and well 9 years after operation. The conditions of the other 3 patients were inoperable; they were seen, on an average of 12 months after the onset of symptoms referable to the growth in the bladder.

ADENOMA AND ADENOCARCINOMA

Adenoma and adenocarcinoma are observed occasionally. In all probability the majority of such growths arise from the glands of Limbeck and Brum, or from the degeneration of small pinched-off epithelial buds. Mucosal glands, well described by Albarran, are found throughout the bladder, especially in the region of the trigone. They are readily recognized and often show colloid degeneration, especially if the mucosa has been subjected to irritating influences, such as stone in the bladder, or exstrophied bladder. The adenomata are usually small, soft, and vascular; occasionally they are pedunculated, but more often flat and circumscribed. In most cases the growths are located in the base of the bladder and are often covered with papillomatous excrescences, especially the pedunculated type. The adenomata are composed of tubules which open on the mucous surface; the glandular lumen is often dilated in its deeper part, forming a cyst. The glands are lined with many layers of cells, often showing mucoid degeneration, as in a case described by Kaltenbach. Watson found 2 adenomata in 653 tumors of the bladder; Motz found 3 in 87 tumors examined histologically, while Geraghty found only 1 in 145 tumors. Cassanello, in 1908, collected 15 cases from the literature and added one case of his own.

Adenocarcinomata of the bladder are closely allied to adenomata and develop similarly. They are usually extensive, flat, and ulcerated, involving the deeper tissues only moderately. Stoerck and Zuckerkand have shown the relationship of these malignant tumors to the mucosal glands; they reported 3 cases. Rauenbusch, in 1905, collected 10 cases of this type of carcinoma, citing 1 case with metastasis to both kidneys. He asserted that the prostate and other neighboring glandular organs must be investigated thoroughly before it can be stated that the tumor is primary in the bladder. These tumors differing from all other vesical growths have a predilection for the upper areas of the bladder, particularly the dome which suggests an origin from remnants of embryonal inclusions.

DeKorté has described a glandular carcinoma removed from the apex of the bladder in a woman, aged 50. The growth did not return, but the patient died shortly after operation. Adami, who examined this tumor, concluded that it originated from urachal remains in the wall of the bladder. Barringer reported a very unusual adenocarcinoma involving only the apex of the bladder; the larger part was above the bladder. Ewing, who examined the tumor, said that the growth was unique and quite possibly came from a remnant of the allantoic end of the bladder, or possibly developed from a cloacal inclusion. Geraghty found three adenocarcinomata in his series of tumors of the bladder; one was in an exstrophied bladder. In one of the cases of Stoerck and Zuckerkandl the tumor was on an exstrophied bladder. They believed that the malignant area developed from the transformation of glandular cystitis which resulted from the continual irritation of the exposed mucosa.

In the series of 262 cases there were five adenocarcinomata.

A man (Case 270742, Figs. 11 and 12) aged 48 years, complained only of a painless hæmaturia of 14 months' duration. At operation a large tumor

in the dome of the bladder and one-third of the bladder were resected. Two years later an inoperable recurrent growth appeared on the anterior wall of the bladder extending into the posterior urethra. The patient died 6 months later. A woman (Case 308263) aged 43 years, had been troubled with mild frequency and suprapubic pains for 12 months. Cystoscopic examination showed a low, sessile tumor of the dome and left wall of the bladder. A transperitoneal resection of the growth, which was 6 centimeters in diameter, was successfully carried out; 6 months later there was no evidence of recurrence. A man (Case 51514) aged 29 years had had hæmaturia and dysuria for 6 months. Four months before coming to the Clinic he had been operated on and a large tumor removed from the bladder. Hæmaturia recurred, and on examination a tumor was found in the dome of the bladder. At operation an indurated growth 10 by 7 centimeters was removed with the upper half of the bladder. Two years later a recurrent growth in the perivesical space 6 centimeters in diameter was removed. One year later this patient was perfectly well. A woman (Case 346328, Fig. 13) aged 50 years had a tumor of the apex of the bladder similar to that described by Barringer, and possibly with a similar etiology. At operation a growth 5 centimeters in diameter was removed from the roof of the bladder. Histologically the growth contained only a few irregular glandular areas embedded in extensive masses of colloid material. Four months later a small local recurrent growth was found in the bladder; it responded readily to fulguration and radium. A woman (Case 190148, Fig. 14) aged 21 years had adenocarcinoma on an exstrophied bladder. This case is similar in etiology to those of Stoerck and of Geraghty. The ureters, in this case, were transplanted to the large bowel and the bladder and malignant area were completely removed. Two years later the patient died from recurrence.

ANGIOMA

Angiomata are rarely found in the bladder. They may be small, and their only symptom a persistent, profuse hæmaturia; or they may be extensive, penetrating into the perivesical tissues, and simulating growths of other pelvic organs. In most cases they are composed of anastomosing dilated cysts filled with blood; rarely they occur as branching masses of apparently recently formed blood vessels, supported by a fibromyxomatous stroma. Watson found only two angiomata in 653 collected cases. Albarran collected 3 cases from the literature and reported one of his own which occurred in a series of 106 cases observed personally. In Albarran's case the tumor, which he removed surgically, was very small; it was attached to the trigone and bled profusely. Thomas has described a similar small angioma which was removed by fulguration. Lane has described a large inoperable cavernous angioma in a child of 3 years. Jungano has described a massive cauliflower angioma in the region of the trigone undergoing sarcomatous degeneration in a man aged 54 years. Launay has reported the case of a girl aged 19, in whom a large submucous angioma was removed from the postero-lateral wall of the bladder. The tumor was firm in spite of many cavernous dilatations.

In the series of 262 cases there were three angiomata.

A girl (Case 14928, Fig. 15) aged 19 years had had pus and blood in the urine, and mild incontinence for 2 years. At operation a large polypoid tumor was found filling an enormous bladder. The tumor extended into the perivesical space through an area about 3 centimeters in diameter. The tumor was completely removed. Four months later a small recurrent growth was successfully fulgurated. Five years later the patient was in excellent health; her bladder appeared normal and its function was normal. The tumor in this case was firm, and contained many blood cysts and sacculations, but the larger part of the growth was composed of fine interlacing blood vessels supported by connective-tissue stroma, simulating a highly vascular myxoma. A man (Case 151866, Fig. 16) aged 76 years had had occasional attacks of hæmaturia and moderate frequency for the last 8 months. On examination an inoperable sessile growth covered with papillomatous excrescences was found on the left base of the bladder reaching up to and involving the urethral sphincter. The growth was extensively fulgurated. Seventeen months later, after a period of comparative relief, the urinary symptoms returned. Examination revealed a wide-spread mass covering the entire left half of the bladder and involving the prostate and posterior urethra. A girl (Case 18434) aged 7 years had had persistent slight hæmaturia for 6 years; recently a small amount of blood had passed from the rectum. A mass 6 centimeters in diameter was palpated in the region of the bladder. Cystoscopic examination revealed an ulcerated bleeding tumor in the base of the bladder. Soon after, before operation could be performed, the patient had a severe hæmorrhage from the rectum and died. Necropsy revealed an extensive cavernous angioma growing from the base of the bladder and invading the rectal mucosa.

MYOMA

Myomata of the bladder are similar to myomata of the uterus. They are rarely a pure type; they are generally fibrous and

Fig. 1. Fig. 2. Fig. 3.

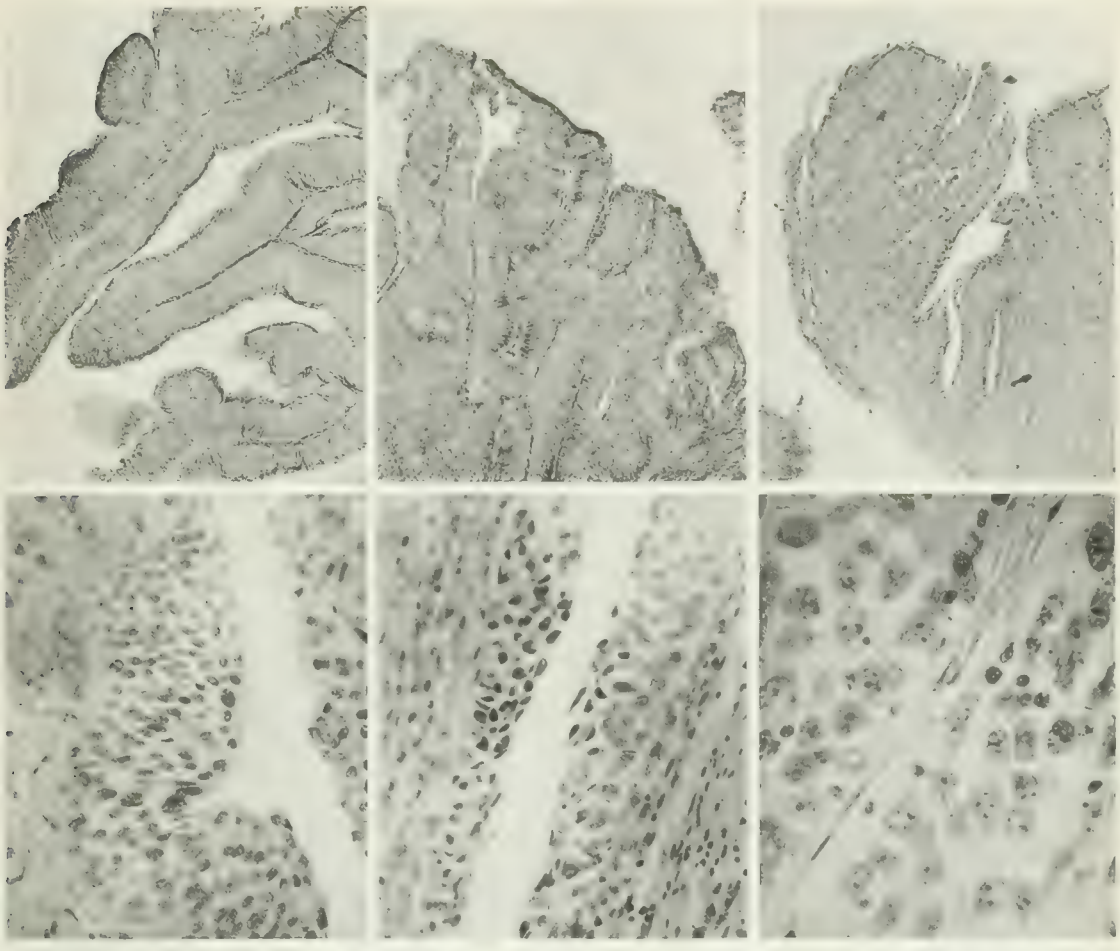

Fig. 4. Fig. 5. Fig. 6.

Fig. 1. Case 110539. Benign papilloma (× 50).
Fig. 2. Case 160671. Papilloma, early malignancy; fusion of fronds with variation in position of cells (× 50).
Fig. 3. Case 113205. Papilloma, showing nests of malignant cells (× 50).
Fig. 4. Case 331733. Grossly benign papilloma, (×200).
Fig. 5. Case 221355. Papilloma showing an extensive area of malignancy (× 200).
Fig. 6. Case 266347. Papilloma, showing connective-tissue axis and adjacent cells of a high degree of malignancy; prominent nucleoli and irregularity in size and shape of cells (× 500).

benign, although they sometimes show malignant characteristics. They are submucous, interstitial, or peripheral types. Profuse hæmaturia is a common symptom and is occasionally combined with a palpably obstructing tumor. They are about equally divided between the sexes and have no predilection for any special period of life, although relatively they are found more often in infancy and childhood. Six of 41 cases reported by Concetti in children were myomata. These growths are generally located on the trigone or posterior wall of the bladder, and are often pedunculated. Blum reports a case of torsion of a myomatous pedicle. The myomata are generally covered with a thinned-out mucosa which often presents an ulcerated, easily bleeding surface. Because of this covering the tumors are not infrequently considered extravesical when examined cystoscopically. The surface of the tumor is often marked with a network of

Fig. 7 Fig. 8. Fig. 9.

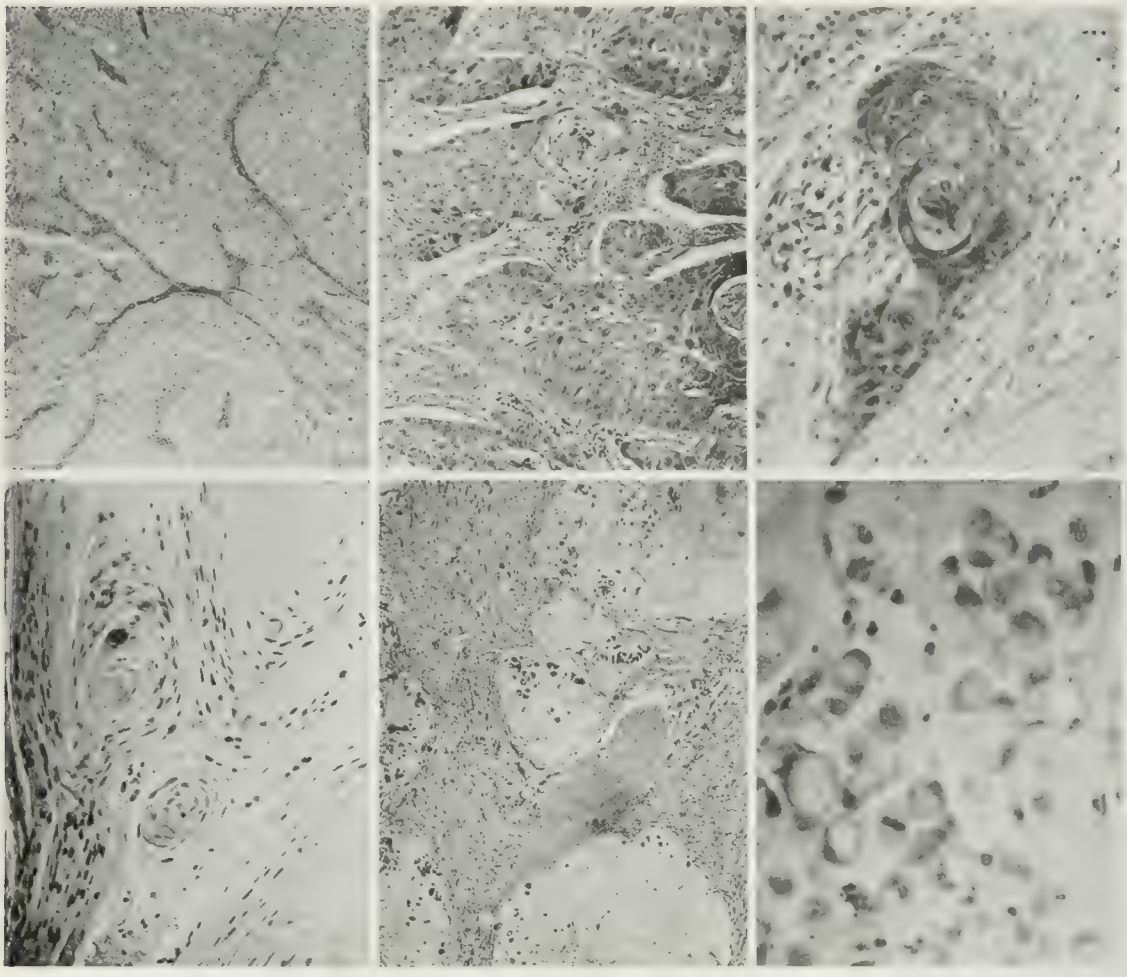

Fig. 10. Fig. 11. Fig. 12.

Fig. 7. Case 103344. Papillary carcinoma, showing altered papillæ and remnants of connective-tissue axis of original papillomatous structure (× 50).

Fig. 8. Case 203917. Squamous-cell carcinoma. Extensive epithelial pearl formation and malignancy of individual cells (× 100).

Fig. 9. Case 203917. Isolated area of squamous-cell carcinoma found in muscular wall of bladder (× 200).

Fig. 10. Case 332791. Extreme hyalinization in squamous-cell carcinoma (× 100).

Fig. 11. Case 270742. Colloid carcinoma; extensive areas of colloid degeneration, and scarcity of cellular elements (× 50).

Fig. 12. Case 270742. Colloid carcinoma shown in Figure 11. Mucous degeneration of individual cells, and an occasional mitotic figure (× 500).

dilated veins. Myomata, in most cases, are relatively large. Polaillon reports a case in which the tumor, removed by laparotomy, weighed 3 kilograms. Kouznetski described an enormous fibromyoma weighing more than 9 kilograms and with a circumference of 68 centimeters. This tumor, which was pedunculated, grew from the posterior and superior wall of the bladder; it extended to the umbilicus and markedly compressed the uterus and rectum. The growth was resected through a median abdominal incision.

Myomata are probably the most common of the connective-tissue tumors of the bladder. Motz found 3 in 87 neoplasms of the bladder. In Watson's 653 cases 16 myomata were

Fig. 13. Fig. 14. Fig. 15.

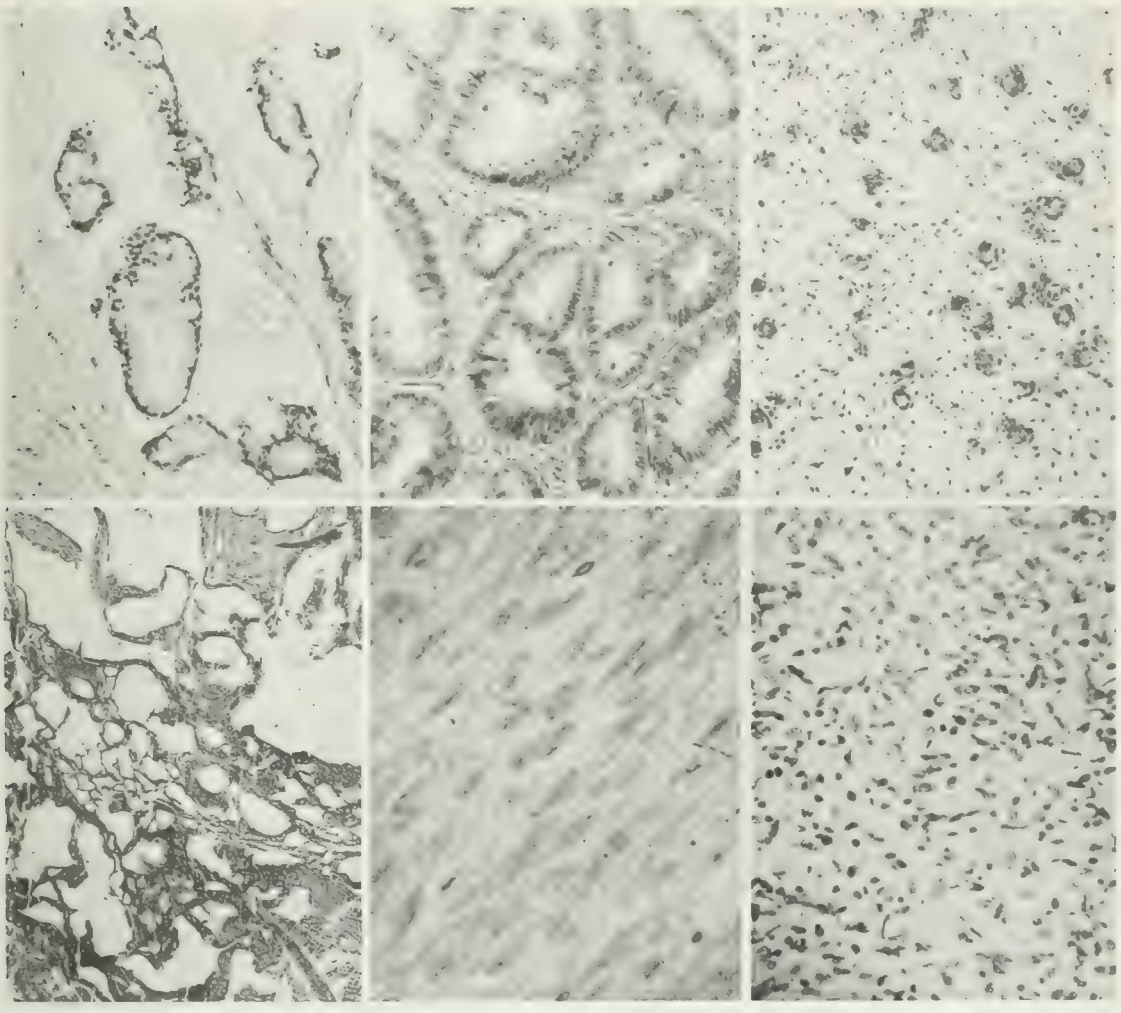

Fig. 16. Fig. 17. Fig. 18.

Fig. 13. Case 346328. Colloid adenocarcinoma of unusual type and location possibly arising from a remnant of the allantois (× 100).

Fig. 14. Case 190148. Colloid adenocarcinoma of intestinal type, occurring on an exstrophied bladder. (× 100).

Fig. 15. Case 149248. Outer border of an angioma, composed of many fine blood vessels; main bulk of tumor is composed of markedly dilated blood vessels (× 100).

Fig. 16. Case 151866. Angioma of the bladder composed of sacculations and dilated blood vessels (× 50).

Fig. 17. Case 62897. Fibroma, showing connective-tissue cells with large oval nuclei (× 500).

Fig. 18. Case 323590. Myxoma of the bladder, composed of round-cell and elongated cells buried in a mass of collagenous material (× 200).

removed surgically. There were three operative deaths in the 16 cases and 5 early recurrences; only 23 per cent of the patients were alive and free from recurrence 1 year after operation. Heitz-Boyer and Doré (1910) collected 32 cases; 25 were simple myomata and 7 were undergoing malignant degeneration. There were 3 operative deaths in the 23 cases in which operation was performed; death occurred in 4 cases shortly after operation, giving an immediate operative mortality of 30 per cent.

There was one case of fibromyoma in this series.

The patient (Case 62807, Fig. 17), a man aged 50 years, had had a painless hæmaturia for years. At operation a hard, smooth tumor 9 centimeters in diameter was enucleated from its attachment to the anterior wall of the bladder just above the sphincter of the urethra. Eight years later the patient was living and well.

MYXOMA

Generally myxomatous tumors are found in infants and children, rarely in adults. They are usually small, although they vary greatly in size, at times almost filling the bladder. They are often multiple and pedunculated, arising from the mucosa in the base of the bladder or from the region of the internal meatus. They are soft, gelatinous, and practically always covered with bladder mucosa, greatly resembling nasal polpys in their structure though they are firmer and more fibrous. Because of their location and pedunculated attachments the tumors often cause obstruction; they grow very rapidly and if not completely removed have a marked tendency to recur. Sims reported the case of a child, aged 3 years, who had almost complete obstruction for 18 months from a myxomatous tumor which blocked the urethral outlet. The tumor was removed through the dilated urethra but promptly recurred. Myxomata have a tendency to become malignant. Mandelbaum reported the case of a child, aged 3 years, from whom specimens removed for examination at different times showed only simple myxoma. Five months later the tumor was removed suprapubically and at this this time histological examination revealed myxosarcoma. Myxomata comprise only a small proportion of neoplasms of the bladder. Sixteen were found in Watson's series of 653 cases. Fourteen of the patients died immediately or shortly after operation. Albarran collected 5 cases and added 1 of his own. Eight of Concetti's 41 tumors of the bladder in infants were myxomata.

There were two cases of myxoma in this series.

One (Case 229590) was a child aged 2 years who had been having urinary difficulty and retention for several months; a soft mass protruded from the urethra. At operation a large, lobulated, soft, friable tumor 8 centimeters in diameter was found. The tumor was completely removed, but the patient died 2 months later. The second child (Case 323590, Fig. 18) aged 16 months had had gradually increasing dysuria for 4 months with recent hæmaturia. At operation an inoperable tumor was found involving the right wall and urethral sphincter. Nine days later the child died. At necropsy the tumor was found to be pedunculated; in its greatest diameter it measured 6 centimeters. The patient also had an extensive generalized miliary tuberculosis.

SARCOMA

Sarcomata, like other connective-tissue tumors of the bladder, occur earlier in life than epithelial tumors. They are exceptionally rare and extremely malignant. They are soft, friable, and not infrequently villous. In the early stages they are small, single, and well localized. Although occasionally they are pedunculated, they usually are sessile, with broad bases. Ulceration is rare; infiltration and extension to neighboring organs is common. Metastasis is extremely frequent. In 46 necropsied cases collected by Munwes (1910) metastasis was found in 50 per cent. Geraghty found only 2 sarcomata in 180 cases. Gardner found seven in 369 cases in which operation had been performed by various urologists. Six of the 7 patients died shortly after operation; the seventh lived 4 years. Watson found 52 sarcomata in 653 collected cases; operation was performed in 35. Twenty-two (63 per cent) of the 35 patients died at operation or immediately after. In 26 cases collected by Albarran 13 patients (50 per cent) died as a result of the operation, and 10 had rapid recurrences or died in a short time after operation. Munwes collected 107 cases; operation was performed in 69; 38 of the patients died soon after operation; only 3 were considered completely cured, having been traced for from 5 to 13 years after operation.

Undoubtedly some of the cases reported as sarcoma are not sarcoma. Fenwick cites a case from Guy's Hospital which had been diagnosed as round-cell sarcoma. Targett re-examined the specimen and found it to be merely round-cell infiltration in a fibropapilloma.

Only one case (Case 3111) of sarcoma was found in the series of 262 cases treated at the clinic.

The patient was a woman, aged 39 years, who had been troubled with frequency and hæmaturia for 18 months. On examination a large, hard mass was felt in the area of the bladder. An inoperable tumor was found in the dome of the bladder. The growth extended into the suprapubic tissues. An excised specimen showed the condition to be a sarcoma. The patient readily recovered from the exploratory operation, but died 2 years later.

SUMMARY

In 168 epithelial tumors of the bladder removed at operation were 3 benign papillomata. The 3 patients are alive on an average of 5 years after operation. In these 168 cases were 71 malignant papillomata and 94 solid carcinomata. Twenty-six (36.6 per cent) of patients in the first group have been dead on an average of 11 months after operation, in contrast to 67 (71.2 per cent) of the latter group who died on an average of 7½ months after operation. Forty-five (43.4 per cent) of the patients with malignant papillomata are alive on an average of 3 years and 3 months since their operation, in contrast to 27 (28.8 per cent) of the patients with solid carcinoma who are alive on an average of 2 years and 3 months. Forty-one and nine-tenths per cent of all patients operated on for malignant papilloma have lived more than 3 years after operation, only 10.6 per cent of patients with solid carcinoma have lived more than 3 years after operation. The incidence of recurrence following operation on patients for solid carcinoma is much greater than that for malignant papilloma. In a solid tumor the local extension is generally more advanced; the removal requires a more extensive operation and the immediate mortality is greater.

Squamous-cell carcinomata of the bladder are extremely malignant and rapidly fatal; 5 of 6 patients with tumors of this type died after a very short period of symptoms.

Adenocarcinomata are about as severely malignant as papillomata. Of 5 patients 1 died 2 years after operation, one had a recurrence in 2 years, three are well, two 6 months and one 2 years after operation.

Simple angiomata of the bladder may grow so large as to cause obstruction. In three cases, one child of 7 died of hæmorrhage from a tumor growing from the bladder to the rectum; a man aged 76 years was first seen in an inoperable condition; and a girl aged 19 years had an extremely large tumor in the dome of the bladder. This was removed, and 5 years later the patient was perfectly well.

Myomata of the bladder often grow very large. There was one patient in the series with myoma. Eight years after the removal of a large tumor the patient was alive and well.

Generally myxomata occur in young persons. Two infants in the series had myxomata; both died shortly after operation.

Sarcoma is probably the rarest and most malignant of vesical tumors. It occurs in middle aged persons, metastasizes extensively, and has a tendency to recur rapidly. The one sarcoma in the series was seen at an inoperable stage.

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DILATATION OF THE COLON SIMULATING HIRSCHSPRUNG'S DISEASE

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THE etiology and classification of the entity termed "congenital idiopathic dilatation of the colon," or "Hirschsprung's disease," has been widely discussed. Hirschsprung himself in one of his later articles divided the disease which bears his name into two types: one type occurring in infancy (true megacolon), and the other in adult life (pseudo-megacolon). From a review of the literature and a study of the cases in the Mayo Clinic it seemed desirable to make a further classification:

1. The congenital type or true Hirschsprung's disease, (a) cases occurring in infancy or early life, (b) cases in which obstinate constipation, abdominal distention, and emaciation have been present from birth, but the patient has grown to adult life (Figs. 1, 2 and 3).

2. Cases in which chronic constipation has been present for years, and in which symptoms

Fig. 1 (346075). Gross specimen of colon shown in Figure 2.

Fig. 2 (346075). Congenital form of Hirschsprung's disease.

Fig. 4 (326996). Megacolon.

Fig. 3 (346075). Hypertrophy of submucosa and muscle layers.

of Hirschsprung's disease developed, within a short period, without demonstrable mechanical obstruction (large fæcaliths are usually present).

3. Cases of megacolon which are due to definite mechanical obstruction, such as (a) those occurring in infancy, due to atresia or stenosis of the rectum, (b) those occurring in adult life, due to tumors, volvulus, adhesions, pressure from without the bowel, or inflammatory stenosis.

The case reported here is of the type classified in Group 3b, and the symptoms were much like those of true Hirschsprung's disease, with the exception that although the patient was constipated from childhood the obstinate constipation had been present only during the last 2 years. Within this time he had also complained of occasional cramp-like pains in the abdomen, which should have suggested the possibility of mechanical obstruction. The roentgenograms revealed megacolon, but whether or not the condition was true Hirschsprung's disease could not be determined.

REPORT OF CASE

Case 326996. Mr. A. W., age 36, came to the Clinic July 30, 1920. In August, 1918, he began to have cramp-like pains in the abdomen, and borborygmus. He had four or five attacks each day, with nausea and vomiting. Following this his abdomen became distended and tympanitic. His bowels had always been constipated, but for the last 2 years the condition had been more marked. Sometimes he did not have a bowel movement for from 5 to 7 days. He had lost 10 pounds in weight in 10 months, and had a dyspnœic cough.

On physical examination marked distention of the abdomen with tympanitis and distention of the veins of the abdominal wall were found. No masses were palpable. A left inguinal hernia was present. Examination of the urine was negative. The systolic blood pressure was 100, the diastolic was 60, the pulse 70. Examination of the blood did not reveal

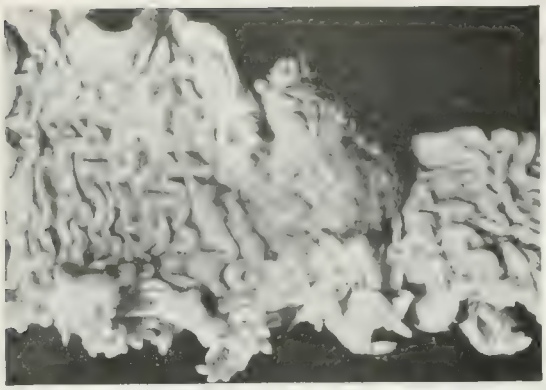

Fig. 5 (326996). Gross specimen of colon including tumor shown in Figure 4.

anæmia. Roentgenograms of the stomach were negative, while those of the colon revealed megacolon (Fig. 4). A test meal gave total acids 10, and free hydrochloric acid 0.

A diagnosis of diffuse dilatation of the colon, probably Hirschsprung's disease, was made, and a modified Brown's operation was performed August 11, 1920 (Sistrunk). The colon was found to be dilated and hypertrophied, most marked in the descending colon and cæcum. The lower 2 feet of the ileum were slightly dilated and hypertrophied. The patient was dismissed in good condition. He returned to the Clinic January 18, 1921; he had had no pain and he had gained 35 pounds.

January 26, 1921, a second operation was performed. There was a very marked dilatation and hypertrophy of the entire ascending and transverse colon to a point in the descending colon near the splenic flexure where a ring-type of growth was found. This proved to be a carcinomatous papilloma of the slow-growing type and was the probable cause of the symptoms. In one area of the growth there was a colloid carcinoma of recent origin. The dilatation and hypertrophy ended abruptly here, and below this point the bowel seemed to be normal. The lower end of the ileum, the appendix, and the colon to a point below the growth were removed, and an end-to-end anastomosis of the ileum to the sigmoid was made over a rubber tube, which was

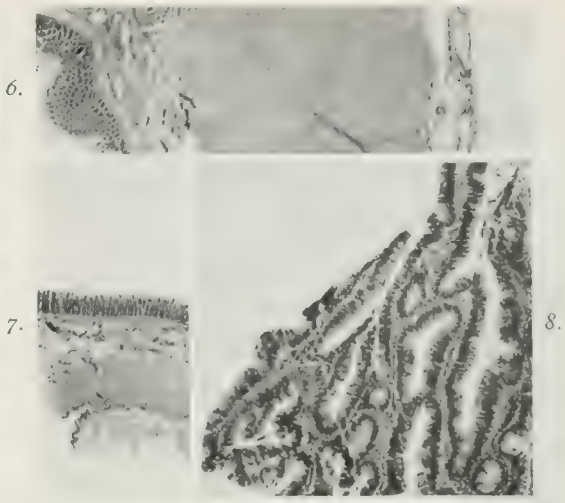

Fig. 6 (326996). Section of bowel above the tumor.
Fig. 7 (326996). Section of bowel below the tumor.
Fig. 8 (326996). Section of tumor (×50).

passed up through the rectum. The patient had an uninterrupted convalescence.

Pathological findings. The specimen consisted of 5 centimeters of the ileum, and of the colon to the sigmoid flexure. There was a growth in the descending colon 50 centimeters from the cæcum, 4 centimeters by 4 centimeters by 2 centimeters, papillary in character. The bowel was constricted at this point. Above the growth the bowel was dilated and hypertrophied; its increased circumference measured 9.6 centimeters and the thickness of the wall was 0.8 centimeters. The rugæ were very prominent above the constriction, while below it the appearance of the bowel was normal; its circumference here was 3.5 centimeters and the thickness of its wall was 0.3 centimeters (Fig. 5).

The microscopic findings in the cases of true Hirschsprung's and the findings in the case reported were very similar. In both there was general hypertrophy, especially in the muscle layers (Figs. 6, 7, and 8).

MULTIPLE PRIMARY CARCINOMATA OF THE PYLORUS AND OF THE ECTOPIC GALL BLADDER[1]

By DR. MORITZ A. RUBEN, Stockholm, Sweden

CASES of primary carcinomata of two or more organs, developing simultaneously and quite independently of one another, are not so very uncommon in the literature and therefore do not seem very peculiar to us. Certainly a clever statistician can determine in what percentage of cases such a combination is likely to occur. However, it is seldom that such cases come to the surgeon for treatment, and with the exception of bilateral carcinoma of the breast, I have not been able to find in the literature a report of operation performed for two such tumors at one time.

The case I shall report is of interest not only as an unicum, but because the location of the tumors possibly supports the theory that mechanical lesions cause the development of malignant growths; and finally, but not least important, the location and the ligamentous connections of the gall bladder are very different than are usually found.

The history of the case is given briefly.

A woman, age 67, single, was admitted May 31, 1920, to Sabbatsbergs Hospital at Stockholm. With the exception of a mild attack of vomiting and diarrhœa 8 years ago, patient has had no trouble with her stomach until 4 weeks before admission. Since then she has had light pains in the right side of the abdomen which came on spontaneously or were induced by coughing. She vomited a few times because she had partaken of improper food but she did not suffer pain and was never jaundiced. Patient was thin but not cachectic; weight 53 kilograms. The temperature rose as high as 38.3° centigrade. The lungs, heart, and kidneys were negative. In the abdomen, to the right and below the level of the umbilicus, I found a round, fist-sized tumor, which moved on respiration and could be moved to either side, but less easily downward. The surface of the tumor felt quite smooth and even, and it was impossible to discover stones or to produce the characteristic sound that is found sometimes in palpating a bladder filled with stones. No adhesions or other signs of an inflammatory process were found in the tissue surrounding the tumor. On the left side of the large tumor I believed I could palpate a smaller one, about the size of a walnut, apparently lying farther back. The liver and spleen were not palpable. No ascites were present and the supraclavicular glands were not enlarged. Nothing of interest was found on examining the pelvic organs, and there was found no connection between the tumor and the ovaries.

In the morning the stomach was found to contain 2 cubic centimeters of a greenish, neutral fluid, but there was no food. The test breakfast, about 90 cubic centimeters, was well digested. Total acidity 24, free hydrochloric acid 7. At three different times with Weber test the fæces were positive for blood. X-ray examination, 7½ hours after barium meal, showed the greater part of the meal in the ileum with lesser amounts in the cæcum. The palpable tumor was easily distinguishable as a dense shadow surrounded by the air-filled transverse colon. Twenty-eight hours after the barium meal we found that by pushing up the transverse colon the shadow followed. There was no stricture of the bowel.

I was not able to make a positive diagnosis, but it seemed to me that I was most probably dealing with a cystic tumor of the mesocolon. I believed that the blood in the stool was the result of a local colitis produced by the tumor, which, according to the roentgenogram, was closely attached to the bowel; the slight increase in temperature doubtless was also caused by the local colitis. The tumor was too movable to be a pancreatic cyst, and furthermore it was not lying in the characteristic position of such tumors. I am sorry to say that I neglected to use the X-ray to examine the pylorus as a possible seat of malignant growth; I did not suppose that the small tumor I felt could be anything other than the larger tumor.

Some days later I operated upon the patient. I used a large, mid-line incision. The larger of the two tumors was situated as anticipated in the transverse mesocolon, close to the hepatic flexure (Fig. 1). It was lying between the two sheets of mesocolon, bulging out the upper surface, and was very closely connected with both, especially with the upper one. In the fossa cystidis felleæ I could not find the gall bladder but instead there was a peritoneal duplication a few centimeters high which was connected with the tumor—a real mesocyst. Here I was able to distinguish a duct, the width of a goose quill, running into the hepaticoduodenal ligament. The tumor had a smooth surface and fluctuated on palpation. In the upper part I found some hard, hazel-nut-sized particles, possibly stones. A few centimeters oral to the pyloric vein I felt in the greater curvature an area of infiltration, the size of a thumb nail and resembling carcinoma. On the inner side of the stomach this tumor had a crater which would admit the end of a finger. The pyloric tumor and the one previously described were so closely connected with

[1] Read before the staff of the Mayo Clinic, February 23, 1921.

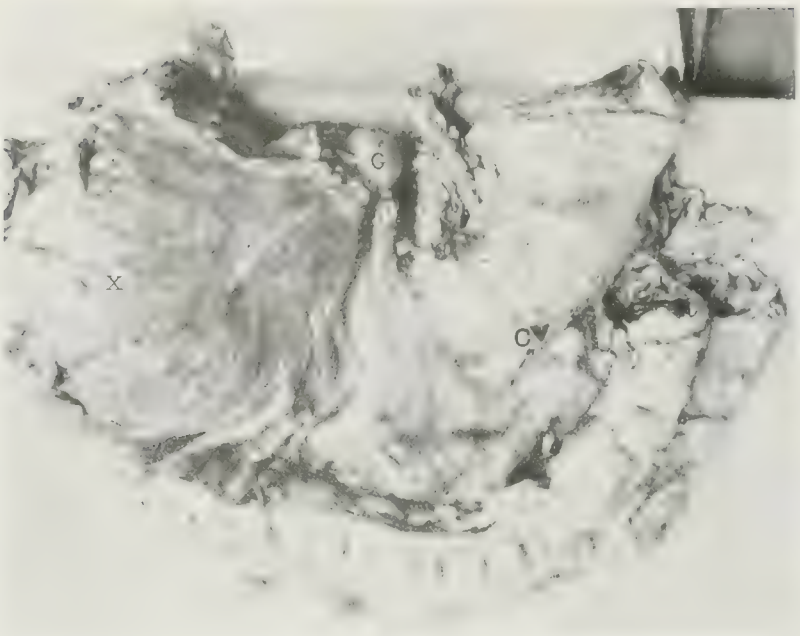

Fig. 1. Photograph of resected specimen showing stomach, gall bladder, involved in tumor mass, and transverse colon. G, gland; C, carcinoma; X, gall bladder tumor.

each other by adhesions that I got the impression that one tumor grew either from the pylorus into the gall bladder, or vice versa. In the lesser curvature I found a large, swollen gland.

Because of the age of the patient and because it would be necessary to resect the colon, there was great risk in doing a radical operation, but this was the only possible thing to do. After ligating the gastric vessels, I resected the duodenum, invaginating the duodenal end, performing the operation in two stages. I then ligated the mesocyst and the cystic duct. It was necessary to resect about 2 decimeters of the transverse colon, and I performed a side-to-side anastomosis and covered the suture line with the remainder of the mesocolon. The nutrition of the bowel appeared good; I could see pulsations in the small vessels close to the resected margins. There was a moderate degree of stretching but this diminished after I made some incisions in the phrenicocolic ligament. The stomach was closed with two continuous rows of sutures and an anterior gastroenterostomy with Braun entero-anastomosis performed.

The patient stood the operation very well, and for the first 5 days conditions were most favorable. For the first time in 10 days the temperature became normal and she complained only of hunger. The next day there was a sudden rise in the temperature, the pulse quickly became rapid, and the patient died of peritonitis.

Pathological examination made by Dr. Reutervall showed the following: The specimen consists of resected parts of the stomach and colon and an ovoid tumor. The tumor measures 10 by 6.5 by 5.5 centimeters. It is surrounded by, and intimately connected with, the colon and with most of the distal part of the stomach. From the upper part of the tumor issues a duct about 3 centimeters in length containing some yellow concrements. The wall of the tumor, which is supposed to be the gall bladder, measures about 2 by 3 centimeters. The outer layers of the tumor consist of normal gall-bladder tissue, the inner layers of a medullary, gray-red, liquefacient tumor mass. Near the greater curvature of the stomach is a typical medullary carcinoma, 4 by 5 centimeters, ulcerating in the middle, and surrounded by elevated walls. The largest part of this tumor is at a distance from the site of the larger tumor of the stomach, which is very intimately connected with the stomach.

A cross section was made through the gall bladder and pylorus, distal to the crater-like ulceration (Fig. 2). Here the wall of the stomach is quite free from the tumor. The wall of the gall bladder is for the most part built up of normal layers of tissue, but in some parts a dense round-celled infiltration is to be found. Only in one part, undoubtedly the starting point of the tumor, is the wall of the tumor made up almost entirely of tumor tissue. This tissue is essentially of the nature of a papillomatous carcinoma. The cells close to the stoma are cylindrical, while the ones on the outside are of a more or less irregular shape. In many parts the papillomatous growth becomes more solid.

Fig. 2. Horizontal section through gall bladder and pylorus above the tumor mass.

Section through the oral margin of the stomach shows an adenocarcinoma with large lumina. Section through the most easily accessible parts of the two tumors shows a free space in which tumor cells are totally absent. In the resected specimen the gall bladder is movable against the stomach.

Fig. 3. Microscopic appearance of the tumor of the gall bladder. (× 350.)

Because of the appearance of the two tumors, the one a carcinoma of the pylorus in a very common location and of a very common shape, the other a tumor involving equally all the wall of the gall bladder, because the tumors were quite different macroscopically as well as microscopically, and because the tumors were of different types,—one chiefly papillomatous, the other adenomatous, I believe we are justified in stating that they are two distinct primary carcinomata.

This case is of interest from two points of view: first, as a case of multiple primary carcinomata; second, because of the situation of the gall bladder and its connections.

Multiple primary carcinomata are not uncommonly described in the literature and in Germany have certainly been favored as a subject for dissertation. In his classical book *Das Carcinom des Menschen*, Ribbert has written a short article on multiple primary carcinomata and quotes cases from the literature. A more complete discussion of the subject is found in the work of Theilhaber and Edelberg.

We have found the following statistics as to the frequency of multiple primary carcinomata. In 507 autopsies on patients dying with carcinomata, Feilchenfeld found not less than 10, or 2 per cent, with multiple primary carcinomata; Hansemann in 1000 autopsies found only 5, or 0.5 per cent; Redlich found the same percentage; in 711 cases, Riechelmann found only 2 cases or 0.3 per cent. Still these figures show that the possibility of two different carcinomata in the same patient is something the surgeon should bear in mind. With the exception of carcinoma of both breasts which is the most common of the multiple primary carcinomata the surgeon seldom finds multiple primary tumors. Some years ago I saw Borelius in Sweden amputate the right breast and at the same time excise an adenoma of the left side. Some days later he was compelled to do a radical operation on the left side also because after careful microscopic examination the growth which was thought to be an adenoma was found to be an independent primary carcinoma.

Cases of even three primary carcinomata appearing in different organs have been described. For instance, Altschul reports a case in which tumors appeared simultaneously on the lip, on the hand, and in the cæcum; and Goetting describes a case in which carcinomata were found in the larynx, the rectum, and the pylorus.

Of course it is necessary to use great care in diagnosing primary multiple carcinomata to avoid confusing them with metastases or

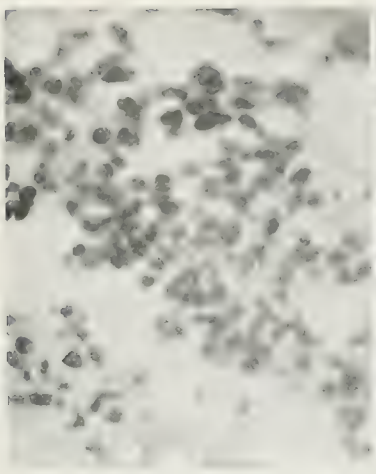

Fig. 4.

Fig. 5.

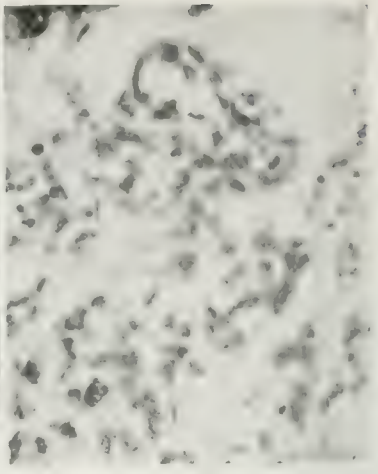

Fig. 6.

Fig. 4. Microscopic appearance of the tumor of the gall bladder. (×500.)

Fig. 5. Microscopic appearance of a section through the pylorus. (×50.) At left, normal mucous membrane; at right, carcinomatous tissue.

Fig. 6. Same as Figure 5. (×500.)

implantations. Billroth, one of the first to write on the subject, was very emphatic in the points which he considered essential in the diagnosis, and would not accept as primary any (1) which did not show a different histological structure; (2) in which the growth could not be traced histologically to the epithelium of its matrix; and (3) in which in each individual growth it was not possible to show its metastasis. These three conditions, which were urged against the earlier too lenient classification, have been considered too rigid by later authors, as, for instance, Bauer, Theilhaber-Edelberg, Hansemann, Bunting, and others. Bauer believes that these three conditions almost never are fulfilled and certainly not the last one regarding metastasis.

Fraenkel reports a case of simultaneous adenocarcinoma of the intestine and scirrhous cancer of the breast in which he could demonstrate, in the thyroid, metastases of these two different types. Richter also reports two cases which meet the rigorous requirements of Billroth—the one an adenocarcinoma of the thyroid gland and carcinoma of the uterus, the second a carcinoma of the uterus and adenocarcinoma of the breast.

That the first requirement of Billroth is not always essential to prove multiple tumors of primary origin is shown by the case of Oberndorfer. In the small intestine, Oberndorfer found four primary carcinomata, all of the same type and size, and lying within a distance of 10 to 20 centimeters from one another. They were covered by an entirely intact mucous membrane and the most scrupulous examination of the lymph vessels of the adjacent parts of the intestine failed to disclose any evidence of infiltration by carcinoma cells. This evidence demonstrates clearly that the first point mentioned by Billroth need not necessarily be fulfilled.

In 1904, Bunting reported the following case from the Johns Hopkins Hospital. In a male negro, age 52, who died from heart disease and in whom the organs were generally free from signs of new-growth, there was found in the middle portion of the ileum six nodules, scattered over about 50 centimeters of the intestine. These nodules varied but slightly in size, and were beneath an intact epithelial surface. The nodules were uniformly of a definitely carcinomatous nature, histologically, apparently originating from the epithelium of the crypts of Lieberkuehn. They showed some invasive tendency but were without metastases in other organs. After discussing the different possibilities and in spite of the fact that all the requirements of

Billroth were not met, Bunting concluded that the negro was the victim of six primary independent carcinomata.

I have not been able to ascertain whether or not the diagnosis in the case with eight primary carcinomata of the vulva reported by Fromme and quoted by Goetting has been verified histologically. If it has been proved, I believe it holds the record to date for the largest number of primary growths.

There has been much discussion regarding cases of multiple primary tumors in one organ. Ribbert, one of the pioneers in such studies, approves only monocentric development; other authors accept the pluricentric theory.

The second requirement of Billroth is still considered necessary to prove multiple tumors of primary origin.

For grouping the tumors according to their location, Bauer has proposed the following: (1) one organ or system of organs—for instance, stomach and rectum; (2) symmetrical organs—breasts and ovaries; (3) different systems of organs—skin and rectum.

Naturally the possible variations are numerous. The combination as in my case has been found but twice and both cases were reported by Feilchenfeld. In one case he found a gelatinous carcinoma of the cardia and carcinoma of the gall bladder; in the other, a carcinoma of the lesser curvature and of the gall bladder.

In our case, of greater and more common interest than this expression of the whim of nature is the singular position of the gall bladder in the transverse mesocolon. It is not possible to say whether this position was a primary or secondary one, but after looking up the literature I am inclined to believe that it was primary.

In a certain number of cases there is to be found a ligamentous connection between the neck of the gall bladder and the transverse colon, called by Spalteholtz "ligamentum hepaticocolicum"; by the French authors ligament cysticoduodeno-epiploique. The best description of this ligament is to be found in the textbook of Poirier, and is based on the very exact investigations of Ancel and Sencert. Poirier states:

"This ligament is but the prolongation of the lesser omentum toward the right. It has the form of a trapezoid blade extending from the liver to the transverse colon, continuing its course to the right flank. The small base bound by an imaginary line, is at the level of the hepatic pedicle. The great base is free. It extends from the fundus of the gall bladder to the right kink of the colon. The upper margin is a continuation of the attachment of the lesser omentum to the liver. It is attached to the neck, the body, and the fundus of the gall bladder. The cysticoduodeno-epiploic ligament is formed of two lamellæ. The anterior one unites with the anterior aspect of the lesser omentum and of the greater omentum. The posterior lamella unites with the posterior aspect of the lesser omentum, passing from the posterior aspect of the duodenum (first portion) to the posterior abdominal wall. Owing to its shape and situation, the cysticoduodeno-epiploic ligament forms with the abdominal wall a funnel which precedes the hiatus of Winslow. Its breadth transversely may reach 10 centimeters from its free edge to the hepatic pedicle. Its maximum height is 6 to 8 centimeters. Its real continuity with the right portion of the greater omentum explains why it has been considered as a cysticocolic ligament."

Figures 1 and 2 in the article of Ancel and Sencert show this ligament as a broad curtain from the fundus of the gall bladder to the mesocolon. From this description I believe it is very easy to imagine such a situation as was found in my case. It is suggested that as the gall bladder from the first has been found movable on its mesocyst, due to the expansion of the tumor it has gradually distended the peritoneal duplication, connecting it with the bowel, and has thus come in closer contact with the transverse colon, finally forming a large mass included in the mesocolon.

Kehr has operated upon several thousand gall bladders and he says that he seldom finds the hepaticocolic ligament. This is not in accord with the opinion of several French authors. For instance, Bricon found the ligament in 21 cases out of 89, 23.6 per cent; Testut in 1 out of 6, 16 per cent; Cohan in 12

out of 40, 30 per cent; Buy in 31 of 100, 31 per cent; Ancel and Sencert in 37 to 60 per cent, in different series. From these findings Poirier concludes that this ligament is a very common one and possible of quite normal formation.

The second abnormality in connection with the case reported is the presence of a mesocyst or ligamentum suspensorium. There are some very few cases reported of this anomaly in the literature, the first by Trew in 1737, by Moseder in 1742, by Soemmering in 1794, by Otto in 1814, and by Courvoisier in 1890. The later author found a peritoneal duplication 1.5 centimeters in width extending from the fundus of the gall bladder to the cystic duct and attached to the liver. For such a formation Krukenberg, in 1903, suggested the name *Wandergallenblase*. After study of the two cases he had operated upon, he suggests that a typical picture of cholecystitis can be produced by such an abnormally movable gall bladder. In his first case, a woman of 25, who had been suffering 2 years from severe attacks of pain, he found the fundus vesicæ near the umbilicus, far from the liver, and resembling more a diverticulum of the intestine. Only by the deep-lying connection with the liver was it possible to identify it as the gall bladder. The operation performed consisted in fixation of the gall bladder to the abdominal wall. Some days later it was opened but contained only normal bile and no stones. The patient rested and did not suffer pain. In the second case Krukenberg found the gall bladder hanging "as a ripe fruit on its stalk" showing no alteration. This patient also recovered after an operation similar to that performed on the first patient.

There is a difference of opinion also as to the frequency of the occurrence of this anomaly. Jacquemet has seen only 1 in 200 cases; other authors report as many as 10 per cent (Gilbert and Parturier) or 16 per cent (Siraud).

Finally I would suggest that the case reported by me supports the theory that some mechanical injury is responsible for starting the malignant new-growth. It is a well-known fact that ectopic organs, as, for instance, the testes, ovaries, and kidneys, are prone to malignancy. In this case the gall-bladder certainly was abnormally movable and by its intimate connection with the pylorus caused a stretching and chronic irritation of this organ. Even Hansemann concurs in this opinion and shows that many of the multiple primary carcinomata involve organs lying close together. He suggests the possibility of a common cause producing these growths.

I would also refer to the researches of Dane Fibigier, who has been able to produce carcinoma of the stomach in rats by feeding them with cockroaches—researches which have put new life into the old theory of chronic irritation as the cause, or at least one of the causes, producing carcinoma. The statistics obtained from the literature are too few and the opinions the different authors too varied to make possible a definite statement as to the normal or abnormal anatomy of the peritoneal attachments of the gall bladder.

It would certainly be of great interest to surgeons who have the opportunity of opening up a large number of abdomens every year if they would pay special attention to the anatomical connections of the gall bladder and of the liver.

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For a more complete bibliography on multiple carcinomata, the reader is referred to the work of Theilhaber and Edelberg; on the abnormalities of the connections of the gall bladder, to the work of Konjetzny.

URETHRAL STRICTURE IN THE FEMALE

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COMPARATIVELY little has been written concerning stricture of the female urethra. The paucity of statistics makes it difficult to determine with any degree of accuracy, its incidence, but most writers agree that its occurrence is rare as compared with urethral stricture in the male. Bagot, writing in 1895, found that 60 cases had been reported since Lisfranc first drew attention to the condition in 1824. In his careful study of the literature to 1887, Herman recognized only 29 cases, the first reported by Earle in 1829. Among 3,000 gynecological patients in Winkel's clinic, 3 were found to have stricture of the urethra. Fischer reported 4 cases from a series of 4,000 consecutive gynecological patients. During many years of active gynecological practice Kelly, in 1908, wrote that he had seen not more than half a dozen cases. Meisel's study showed that in Vienna clinics there were 378 urethral strictures found in the male to one in the female.

Otis believed that there were "strictures of large caliber" which had been entirely overlooked by the profession. He read a paper on this subject before the New York Academy of Medicine in 1874, but later discovered that Civiale had called attention to this condition in 1850. I have found only one other champion of Otis' belief, Van de Warker, who in 1887 argued that the profession was overlooking a very definite lesion as described by Otis. Other investigators, however, have not confirmed his opinion.

Fig. 1. Cystogram obtained January 12, 1920, after injecting 500 cubic centimeters of 15 per cent sodium iodide solution. Note the upward projection of the fundus of the bladder, the greatly enlarged and tortuous right ureter and a diverticula or lower end of the left ureter.

Fig. 2. Cystogram obtained January 24, 1921, after injecting 250 cubic centimeters of 15 per cent sodium iodide solution. Note the general similarity of outline of the bladder compared with the cystogram obtained a year ago. The bladder held only one-half as much fluid as it did a year ago.

Authors of gynecological and urological text-books have paid little attention to urethral stricture in the female and usually have dismissed the subject in a few sentences describing it as a rare condition of small importance.

ANATOMY

Anatomists give the dimensions of the normal female urethra (on physiological distention) as 3.5 centimeters in length and 7.5 millimeters in diameter with a spindle-formed dilatation in the middle portion. Embryologically it corresponds to that portion of the male urethra between the internal orifice and the openings of the ejaculatory ducts. Normally except during the act of voiding, the walls of the urethra lie in longitudinal folds in contact.

The meatus varies greatly in shape due to the presence of the wing-like folds of mucosa, called the labia urethræ, which are usually present in women who have not borne children. It may be a sagittal slit or a triangular, circular, oval, crescentric, cruciate, or stellate opening. As in the male the meatus usually has the smallest diameter of any part of the urethra. Hunner says the average diameter is 7 millimeters and that the great majority are from 6 to 8 millimeters. Herman measured 56 normal urethræ in women between the ages of 18 and 70 years and found that they varied between 7 and 12 millimeters in diameter as tabulated below:

2 measured	7 millimeters in diameter,
11 measured	8 millimeters in diameter,
21 measured	9 millimeters in diameter,
15 measured	10 millimeters in diameter,
6 measured	11 millimeters in diameter,
1 measured	12 millimeters in diameter.

Herman did not believe that child-bearing has any influence upon the caliber. I have recently seen a women 30 years old, II-para, in whom the meatus measured 15 millimeters; and another woman of 65 years of age, the mother of 7 full-term babies, whose meatus was only 4½ millimeters in diameter. The urethra in each of these women is perfectly normal except the unusual size. There was no evidence in the older patient of the senile thickening described by Herman.

Posteriorly at the meatus there is a small papilla, on the lateral and posterior portion of which are the minute orifices of Skene's glands. The urethra is lined with stratified squamous epithelium except near the bladder where it is of the transitional type. It is minutely pitted with the openings of small tubular alveoli which often open into small depressions called lacunæ. The bladder is shut off from the urethra by the internal sphincter muscle.

LOCATION OF STRICTURES

Strictures may be located in any part of the urethra, but the external meatus and the anterior portion are the favorite sites. Bagot says that the most common site is in the anterior third of the urethra. Skene calls attention to stricture of the internal orifice. Several authors report cases in which there was contraction of the entire urethra. Both the anterior and posterior portions have been involved in a few cases of multiple stricture.

ETIOLOGY AND PATHOLOGY

The great majority of strictures are single although multiple ones have been reported.

Strictures are classified as traumatic, inflammatory, neoplastic, congenital, senile, and unknown.

Traumatic strictures are due to cicatricial tissue resulting from tears or from the destruction of tissue from crushing and sloughing. This type of stricture may follow injuries during childbirth, or be caused by accidental injuries, intra-urethral masturbation, burns and scalds, operative injuries, or by the application of strong caustics. Injuries during childbirth involve the urethrovaginal septum though not necessarily the entire wall of the urethra, as contracting bands in the anterior vaginal wall may compress the urethra dangerously. A tear through all the coats of the urethra may cause a complication of fistula with the stricture. Injuries due to accidents may be similar in effect to the injuries of childbirth, although in these cases the injury may be confined to the external meatus or may be intra-urethral. Cicatrices following burns and scalds are located at the external meatus. Skene believed that the application of caustics was the most common cause of the condition.

Inflammatory strictures follow gonorrhœa, syphilis, tuberculosis, chancroids, and other diseases which cause ulceration of the vulva, such as diphtheria. Inflammatory strictures form a very large class and most authors agree that the diplococcus of Neisser is by far the most common cause. A localized thickening of the wall following urethritis is the usual lesion. Syphilis sometimes results in a general induration and contraction of the entire canal, but cicatrices of healed chancres located intra-urethrally, around the meatus or on the anterior vaginal wall, are more common. Lewin reported a series of 612 females with pseudo-syphilitic ulcers only 6 of which involved the urethra alone and 5 both the labium and urethra as compared with a series of 638 males, in which series the urethra was involved in 21 cases. Meisel mentioned diphtheretic ulceration of the vulva as a cause. Fischer cites one case following typhus fever. Tuberculosis is mentioned as an etiological factor although I have not found any cases reported.

Little known conditions, called kraurosis vulvæ and lupus vulvæ (non-tuberculous), also cause stricture. Bagot reports one case due to an old kraurosis vulvæ. Several cases of stricture have been reported among women suffering from a disease designated as lupus vulvæ in which small multiple tumor masses surround the meatus.

New-growths causing stricture are generally carcinoma and rarely sarcoma. Johnson states that intra-urethral tumors never cause stenosis of the canal but Fischer includes polyps, vascular and fibrous tumors and phlebectases as well as malignant tumors. Extra-urethral malignant growths sometimes involve the urethra causing stenosis, but primary urethral malignancy is extremely rare. The only case I have seen which was due to malignancy, was incident to a huge pelvic sarcoma filling the entire pelvis and completely surrounding the urethra. Kleinwachter saw one case of benign tumor of the urethra causing stricture, and mentioned one case from the literature (David's case). Extra-urethral tumors compressing the canal are probably more common than true stricture, but we shall not consider them here.

Congenital stenosis is quite rare. Blum and Fissiaux each reported a case in which there were both persistent urachus and patent umbilicus. Jaboulay reported a case of pyelonephritis following congenital stricture. Johnson stated that this type is usually situated at the internal sphincter or in the posterior third of the urethra. Skene also mentions the occurrence of congenital stricture.

A general thickening and induration of the urethrovaginal connective tissue, considered a hyperplasia, of unknown cause, found in women over 50 years of age, is called senile stricture by Herman, who says he was the first to call attention to this type of stricture. He collected six cases from the literature and added three of his own. He believed it analogous to prostatic hypertrophy.

Kelly mentions extreme contraction of the external meatus without assignable cause. Skene drew attention to the general contraction of the urethra in patients who had suffered for a long time from vesicovaginal fistulæ.

Foreign bodies and impacted stone may cause stenoses which are not to be considered as true strictures. Spasmodic stricture is not considered here as it is not an organic stenosis.

SYMPTOMS AND DIAGNOSIS

The onset is usually gradual and the course progressive. In some cases the only symptoms noted by the patient are the small stream voided and the length of time required for the act of voiding, but in the great majority of cases there is also some degree of dysuria. Occasionally acute retention may first cause the patient to consult a physician. All of the cases seen by Fischer were referred with a diagnosis of cystitis. Case reports by various authors mention such other symptoms as strangury, pollakiuria, ischuria, nocturia, nycturia, tenesmus, and dribbling.

Skene says that "a slight stricture at the vesical neck causes symptoms out of proportion to the extent of the stenosis. He suggests that this may be due to interference with the internal sphincter muscle.

Van de Warker and Genouville claimed that symptoms appear sooner in women than

in men and explained this by the fact that the female bladder is less muscular than that of the male. Van de Warker believed all symptoms of urethral irritation which are relieved by dilatation, to be due to "strictures of large caliber," as described by Otis. He stated that he had never seen a female urethra smaller than 16 F.

The diagnosis is made by examination with sounds or, preferably, olive tipped or bulbed bougies. In certain cases the strictured area can be felt through the vagina. The endoscope is necessary for a complete examination.

The differential diagnosis includes consideration of cystitis, trigonitis, urethritis, urethral ulcer and bladder ulcer, tumors and displacements and malformations of the urethra, interferences with the normal bladder function by the pressure of the gravid uterus or of pelvic tumors, and lastly retention from other causes.

TREATMENT

The methods used to cure or to relieve the condition are similar to those used in combating like conditions elsewhere.

Gradual dilatation of the stricture with sounds, bougies, or Hegar dilators over a considerable period of time has proven effective in some cases. This operation is carried out after a local anæsthetic has been applied to the urethral mucous membrane. The dilating instruments should be generously lubricated before insertion and the largest instrument passed at any sitting should be left in place for 10 to 15 minutes. The size of the dilators used must be determined each time by the degree of pain caused. It is necessary to avoid any very severe pain when the treatments are so frequently repeated, as well as to avoid considerable trauma. At first daily treatments are given, but later the intervals between sittings can be increased, and the treatments should be continued over a period of several months.

These patients ought to be warned that recurrences are common, and that for this reason they are to return several times a year for dilatation. In some cases reported the dilators were left in place for 6 hours each time.

Rapid dilatation with sounds is also used after the patient has been subjected to a general anæsthetic. Caudal anæsthesia could be used for this purpose. In a few of the reported cases this operation was repeated several times within 3 weeks. The results are reported to be satisfactory. Gilliam treated his patient by digital dilatation, breaking up adhesions of the opposing surfaces in the posterior third of the urethra, and noted that the sensation was similar to that felt when the finger is thrust into a recent wound. The patient passed bloody urine after the operation.

Van de Warker advocated treating "large caliber strictures" by forcible dilatation and the high-grade strictures by gradual dilatation two or three times a week for 3 months.

Herman spoke of one case of stricture at the meatus causing acute retention. This patient was relieved by a trocar puncture through the meatal region as the operator was not able to find any opening. This stricture was doubtless of long duration as the urethra behind the meatus had become greatly dilated. The treatment was continued by passing rubber catheters every 6 hours until the patient voided spontaneously, and later bougies were passed several times.

Otis reported two cases treated by divulsion and digital dilatation and exploration. He also performed internal urethrotomy in one case and later was forced to repeat the operation. He advocated extreme dilatation up to 70 millimeters (in circumference) and reported a subsequent temporary incontinence in one case. Fergusson practiced internal urethrotomy in one case. External urethrotomy has been performed in some cases. If the lesion is close to the external meatus complete division of the septum, producing a permanent artificial hypospadias, may be the most practical solution.

In that type of stricture caused by vaginal scars or bands a resection of the scar and longitudinal suture of the wound may be necessary if incision of the cicatrix is not sufficient to relieve the stenosis. Bagot resected the involved section of the urethra in one case of traumatic stricture with good results.

Newman and Fissiaux reported good results following treatment by electrolysis. In one of Newman's 5 cases repeated dilatations had been unsuccessful. At the present time urologists condemn the method as useless.

Kelly suggests the use of radium for treatment but has had no opportunity to test its value.

Where vesicovaginal fistula complicates the urethral stricture, the latter must be treated before the fistula is closed. Granular urethritis and ulcers complicating stricture should be treated through the endoscope. Cystitis and pyelonephritis are the most serious complications and require the attention necessary in such diseases.

PROGNOSIS

If the lesion is due to vaginal bands or scars that can be resected with longitudinal suture of the wound, cure is assured. The condition is prone to recur after single dilatations and urethrotomies but by following the patients carefully with further occasional dilatations, cure can usually be attained. The disease is not serious unless retention and infection of the upper urinary tract intervene. Chronic retention followed by dilatation and hypertrophy of the bladder with hydroureters and hydronephroses ends in pyelonephroses. Acute retention may result in rupture of the bladder. Thompson draws attention to the specimen in the museum of the Royal College of Surgeons of Edinburgh placed there by Sir Charles Bell and described as follows: "(No. 2020, xxxi, G.) Bladder of a woman age 39, ulcerated, ruptured. The urethra is seen to be strictured. The cellular tissue between the peritoneum and abdominal muscles was filled with urine. The stricture is a narrow one, the bladder hypertrophied."

The stubbornness of some of these cases Skene illustrated by a report of Dr. Munde's case in a woman of 22 years, unmarried. This patient was treated by electrolysis for 4 months with no relief, then followed tonic treatments and bladder irrigations, digital dilatations of the urethra and a self-retaining catheter for a long period until finally Dr. Emmett performed a vaginal cystotomy as a last resort. After a year of these various treatments this patient was not relieved.

I shall present a short summary of the cases I have found in the literature at my disposal.

The ages given in a series of 47 cases range between 19 and 70 years.

	Cases
19 years of age	1
20 to 30 years of age	12
30 to 40 years of age	9
40 to 50 years of age	8
50 to 60 years of age	10
60 to 70 years of age	6
70 years of age	1

In a series of 21 cases 4 had never been pregnant, 5 had borne one child, and 12 were multipara.

The etiology as shown in 51 cases is as follows:

	Cases
Injuries due to childbirth	11
Gonorrhœa	11
Senile stricture	10
Syphilis	6
Lupus vulvæ	3
Congenital	2
Neoplasm of the urethral wall	2
Healed ulcer	1
Trauma	1
Accidental burn	1
Kraurosis vulvæ	1
Typhoid fever	1
Typhus fever	1

The location of the strictures in a series of 38 cases is as follows:

	Cases
Entire urethra involved	4
External meatus	9
Anterior third	14
Middle third	7
Posterior third	4

The calibers of the stricture are given in a variety of ways but I have attempted to estimate the diameters in millimeters as far as possible in a series of 33 cases.

In 8 cases the urethra measured 2 millimeters.
In 7 cases the urethra measured 3 millimeters.
In 4 cases the urethra measured 4 millimeters.
In 1 case the urethra measured 5 millimeters.
In 2 cases the urethra measured 6 millimeters.
In 4 cases the urethra was "very small."
In 3 cases the urethra just admitted probes.
In 1 case the urethra admitted the finest bougie available.
In 3 cases the examiners were unable to introduce probes and were forced to puncture the bladder with trochars through the region of the meatus.

The numerous methods of treatment are described as follows in a series of 55 cases:

	Cases
Gradual dilatation	20
Rapid dilatation	12
Internal urethrotomy and dilatation	5
Electrolysis	5
Passing of catheters	4
Puncture and dilatation	3
Removal of tumors and dilatation	3
Division of urethrovaginal septum near the meatus	1
Resection of the stricture	2

In a series of 42 cases, cure was reported in 28, improvement or relief of symptoms in 10, while 4 were not benefited.

I have seen a negress who had had occasional dilatation of multiple strictures over a period exceeding 10 years. This patient would come to the dispensary for treatment only when retention occurred and after dilatation and catheterization would not be seen again for months. She had both syphilis and gonorrhœa.

Case 1. The patient, a widow, age 59, was referred to me January 6, 1920, by Dr. W. A. Fansler. She complained of a painful tumor at the urethral orifice, chronic retention of urine and great pain on catheterization. The family history was unimportant.

The patient had always been a healthy woman until her present illness. She was married 42 years ago and had given birth to eleven full-term children. The labors and puerperia were normal. Her menopause occurred 10 years ago.

For a very long time (at least 20 years) patient has noticed that she voids a very small stream and that the time required for voiding is longer than before her marriage. However, she has had no other symptoms until April, 1917, when an attack of frequent urination began suddenly, lasted about 2 months and stopped as suddenly as it began. She felt well until October, 1918, and had no further symptoms. At this time she noticed an almost constant thirst which has continued in greater or less degree ever since. In March, 1919, the patient began to have frequent vomiting attacks as often as every half hour, and occipital headaches, and her daughter noticed a peculiar odor to her breath. There was some œdema of the feet at this time. In May, 1919, a diagnosis of an inoperable, malignant, pelvic tumor and chronic nephritis was made. The symptoms increased in severity, her weight dropped from 200 to 130 pounds and she grew very weak. In August, 1919, a diagnosis of distended bladder was made and after a prolonged attempt a very small catheter was inserted into the bladder and five pints of urine drained out. The catheterization caused her excruciating pain. Since that time she has been catheterized twice or three times every day. Since the first catheterization the condition of patient has steadily improved; the vomiting and headaches have ceased, weight has increased and strength has returned.

Physical examination. On general examination nothing remarkable was found except a moderate dorsal kyphosis, some œdema of the legs and a slight bronchitis. The pulse, respirations, and temperature were normal. The blood pressure was 168 systolic, 100 diastolic. Leucocytes 13,000, erythrocytes 3,600,000, hæmoglobin 50 per cent. Differential count: lymphocytes (small and large) 21 per cent, large mononuclears 6 per cent, transitionals 2 per cent, polymorphonuclear neutrophiles 70 per cent, eosinophiles 1 per cent. A 24-hour specimen of urine measured 1500 cubic centimeters, specific gravity, 1.011; albumin; no sugar; acetone, faint trace; diacetic, negative; microscopic, a large amount of pus obscures the field. Phenolsulphonephthalein 5 per cent in 2 hours and 10 minutes. A pure culture of bacillus coli was grown from the bladder urine. The patient was examined by Dr. T. A. Peppard who reported the following results of tests: Blood sugar .092, creatinin 4.7, urea 29, Van Slyke 44, amount recovered from Ewald test meal 120 cubic centimeters, total acidity 40 per cent, free hydrochloric acid, none, lactic acid +, Oppler Boas bacillus 0, blood negative (to macroscopic, microscopic, and chemical examination).

Gynecological examination. The breasts and abdomen were normal. The pelvis was normal except for a senile atrophy of the external genitalia and a small cystocele. External hæmorrhoids were present but the rectum was otherwise normal. The urethral mucosa was everted and exquisitely tender. A thickened bladder could be felt bimanually. A local anæsthetic was necessary for catheterization, and even then was extremely painful. An obstruction was met .5 centimeter within the meatus. A cystogram with 500 cubic centimeters of 15 per cent sodium iodide showed a dilated bladder with small diverticula and a tremendously dilated right ureter and kidney pelvis.

Cystoscopic examination. Under local anæsthesia the urethra was dilated to No. 9 Hegar (9 millimeters in diameter). There was definite contraction of the urethra at 5 millimeters above the external orifice and again 1 centimeter below the vesical sphincter which admitted a No. 5 Hegar with some difficulty. The bladder was examined through a No. 8 Kelly cystoscope and found to be heavily trabeculated with a moderate degree of general cystitis present. On account of the patient's very nervous condition the examination was unsatisfactory and incomplete. On examination of the urethra an area 3 by 5 millimeters of superficial ulceration was seen 1 centimeter below the vesical sphincter. April 8, 1920, under gas and oxygen anæsthesia the everted urethral mucosa was resected.

After being under treatment for a year the patient's general condition has improved due largely

to more frequent and less painful catheterization. She has gained 13 pounds, feels stronger, has no œdema, and the distressing thirst has been relieved. But there is no apparent change in the urine, her residual is still from 200 to 450 cubic centimeters, and the phenolsulphonephthalein output is only a trace in 2 hours and 10 minutes. Her blood pressure is 140 systolic and 96 diastolic. A cystogram obtained January 24, 1921, after injecting 250 cubic centimeters of 15 per cent sodium iodide solution shows the bladder about as before except of smaller size.

The interesting part of the cystograms is the truncated cone effect of the fundus. The cause of this we are not at present prepared to state but it suggests three possibilities: adhesions to the fundus, a very broad based diverticula or a partially patent urachus (this latter explanation was suggested by Dr. Guy L. Hunner). It seems to me that the last suggestion is the most probable explanation, although I do not believe the stricture of the urethra is congenital.

Case 2. An unmarried woman, 20 years of age, was first seen April 21, 1920, suffering from acute gonorrhœal urethritis, vaginitis, and endocervicitis. Under treatment smears became negative for gonococci. She returned on November 8, 1920, when a few gonococci were found in smears from the cervix and urethra. Following a course of treatment sounds were passed. There was a definite obstruction one centimeter above the external meatus, to a No. 5 Hegar dilator which was dilated to No. 9 Hegar. Endoscopic examination showed the urethra normal except in the middle third where there was an annular area about 2 millimeters wide which was reddened and bleeding slightly at one point. This patient is still under treatment for the stricture.

CONCLUSION

Urethral stricture in the female is an unusual condition, sometimes followed by serious secondary involvement of the entire urinary system and is often resistant to treatment.

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TUBERCULOUS APPENDICITIS

Report of a Case

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BECAUSE there are comparatively few reports in the literature regarding tuberculous appendicitis and so little is said of it in the textbooks, we wish to report the following case.

Miss H. H., age 31, discovered that she was suffering with pulmonary tuberculosis 13 years ago. Six years ago she had an ischiorectal abscess, which was incised. On several occasions she had coughed up small quantities of blood. Bacilli were found in her sputum 8 months ago, when her present physician, Dr. Kummer, first saw her. Her sputum had not been examined before that. In spite of her pulmonary condition these many years, she has been up and around most of the time and has helped with the house work.

Ten years ago, 3 years after she knew that she had tuberculosis of the lungs, she had her first attack of pain in the abdomen, which was diagnosed appendicitis at that time. Since then she has had similar attacks with increasing frequency.

Her present attack began 4 days ago with pain throughout the abdomen, the pain localized in the right iliac fossa, where it has been ever since. There has been no vomiting and the bowels have moved. The temperature has been normal throughout.

Physical examination. The abdomen was soft, but at McBurney's point there was a distinct local tenderness and a small mass could be felt. This was made possible by the fact that the patient was thin. There was no tenderness in any other part of the abdomen. Pelvic examination through the rectum was negative. Examination of the lungs showed definite signs of tuberculosis at both apices, but no cavities of any appreciable size. The urine was free from albumin and sugar. Temperature 98.8°F., pulse 90.

Clinical diagnosis. Subacute exacerbation of a chronic appendicitis.

Appendectomy under gas-oxygen anæsthesia seemed indicated in spite of the pulmonary condition.

Operation, February 4, 1921. Gas-oxygen anæsthesia. A Kammerer incision was made and the appendix easily found. It was very much swollen and reddened, but not at all adherent. The peritoneum in its vicinity was somewhat reddened. There were no tubercles or other signs of tuberculosis on the peritoneum, cæcum, or any other part of the abdomen that could be inspected. The tubes and ovaries were also examined and found normal. The appendix was removed in the usual way, cauterizing the stump and inverting it by means of a linen purse-string suture. On section, the appendix showed no pus, but a peculiar thickening of the submucous tissue described below. The wound was closed in layers without drainage.

The patient showed no reaction from the operation, the temperature and pulse remaining normal and the bowels moving on the third day. She sat up out of bed on the eighth day and left the hospital on the ninth day. Her wound healed perfectly. Her pulmonary condition was apparently not affected by the operation.

Microscopic examination of the specimen showed that the normal structure of the mucosa and the submucosa had disappeared. In its place we found besides a few epithelial glands a thick, connective-tissue layer which was infiltrated with lymphocytes and polynuclear leucocytes and contained typical tubercles. Very marked polynuclear infiltration and beginning abscess formation was observed at the border between the submucosa and muscularis.

The muscularis showed also cellular infiltration. A single small tubercle was seen in the space between the circular and longitudinal layers.

The serosa was thickened and œdematous and presented many new-formed capillaries. It was infiltrated with fibroblasts, lymphocytes, eosinophile leucocytes and plasma cells. Tuberculous changes were not present.

The tuberculous lesion in this appendix was confined to the mucosa and submucosa and was beginning to infiltrate into the muscularis. Whether it started in the mucosa or in the submucosa, cannot be decided, as the changes are already too far advanced. The infiltration with polynuclear leucocytes and the abscess formation indicate a secondary, acute inflammatory process.

Microscopical diagnosis: Tuberculosis of the appendix with acute exacerbation.

The rarity of tuberculosis of the appendix alone would make this case of interest. It occurs in from 0.16 to 3 per cent of all appendices examined, according to the reports of the various observers who have reported their findings. Among 515 appendices which came under observation in the State Institute for the Study of Malignant Disease[1] in Buffalo, New York, 23 or 4.4 per cent were found to be tuberculous. In 11 of these

[1] We are indebted to the State Institute for The Study of Malignant Disease in Buffalo, N. Y. (Dr. H. R. Gaylord, Director), for the permission to use its material.

twenty-three appendices the lesion was confined to the peritoneal surface, while the muscularis, submucosa, and mucosa were intact. Only the remaining 12, or 2.3 per cent of all the appendices examined, showed tuberculosis of the mucosa and submucosa. In the majority, the muscularis was also invaded, while in a few specimens all the structures of the appendix presented tubercles.

This case is of particular interest on account of the fact that no other part of the intestinal tract, peritoneum, or pelvic organs was involved. Usually tuberculous appendicitis is part of a general miliary tuberculosis or is secondary to ileocæcal tuberculosis or tubercular salpingitis. Scott, however, says that ileocæcal tuberculosis is secondary to the appendiceal tuberculosis. Whether this case would have progressed to ileocæcal involvement is doubtful, as the symptoms were of such long standing. However that may be, this was a case of primary tuberculosis as far as the abdomen and pelvis were concerned. True primary tuberculous appendicitis is exceedingly rare. Kelly and Hurdon could find only three cases in a careful search of the literature. In these cases there was complete restoration to health after appendectomy; but even there an undetected healed lesion somewhere in the body might have existed.

On the other hand, extensive involvement of peritoneum and tubes may occur without reaching the appendix, as evidenced by a recent case in which there was a tuberculous salpingitis and a general tuberculous peritonitis, but in which the appendix, although bound down by adhesions, was itself free from tuberculosis.

In this case, infection of the lung apparently preceded infection of the appendix. Whether it was carried to the appendix by the blood stream or was due to the swallowing of tubercle bacilli with subsequent lodgement in the appendix, just as occurs with any other foreign body, cannot be definitely determined. It seems more probable, however, that it was due to the latter cause, for we know that the bacilli were there to be swallowed. That raises the question whether a true primary appendicitis might not be caused by eating infected food.

In the usual classification of tuberculous appendicitis into miliary, ulcerative, and hyperplastic types, this case belongs to the hyperplastic type. This is the most favorable type, for the marked tissue proliferation indicates a good resistance. That this patient had good resistance is shown by the fact that in spite of the long standing of both the pulmonary and appendiceal conditions, she did not succumb to either of them.

In the diagnosis of this case, the absence of temperature and the feeling of a mass are of interest. Both are characteristic of the hyperplastic type, although even in this there is usually some afternoon temperature. The mass might be mistaken for a new-growth, but its tenderness would help to differentiate it. With the pulmonary lesion, the normal temperature, the mass, the absence of rigidity, and the chronicity of the condition, the diagnosis ought to have been made in this case with a reasonable amount of confidence. It was considered as a possibility, but on account of its rarity, the suppurative form seemed the more probable.

Routine pathological examination of all appendices and more complete reports would help greatly to increase our knowledge of this rather obscure condition.

THE ABDOMINAL SURGEON OF THE FUTURE[1]

By THOMAS S. CULLEN, M.B., Baltimore

FOR a few moments this evening I want to discuss what has already been accomplished in abdominal surgery, and briefly to point out the lines along which further advancement may be made. As the gynecologist was the pioneer in abdominal surgery I shall discuss pelvic lesions first, and later those of the upper abdomen.

Displacements and lacerations of the pelvic structures have been carefully studied, appropriate operations have been thought out, and after years of labor it is now possible to relieve and often cure these patients.

Pelvic infections have ever been the bugbear of the gynecologist. We now know that it is wiser to refrain from operating in acute diplococcus infections, and that in some cases the inflammation will subside totally. When the process is chronic and pus tubes are present, they are usually removed, but with our better knowledge we now make every effort to save one or both ovaries or even a part of an ovary. The necessity for this conservatism has been rendered perfectly evident by the distressing and more or less permanent sufferings of patients from whom the ovaries were removed long before the natural menopause, often as a routine procedure in inflammatory cases. I cannot too strongly urge the greatest conservatism.

The surgeon is now fully aware of the usual location of and of the most frequent cause of puerperal infections, and when called within a few weeks or occasionally months after delivery, he opens the indurated broad ligament area from above and extraperitoneally, making an incision above and parallel to Poupart's ligament, and in this way is able to eradicate the focus of the disease without entering the peritoneal cavity. This subject I discussed at length from this platform at a previous meeting of the Congress.

How well we remember physician after physician coming to our clinic and saying: "I cannot understand how you find so many cases of tubal pregnancy, I have never seen one in my practice," whereas not a few of these same men now instantly diagnose this condition. Although a certain percentage of tubal pregnancies must necessarily remain obscure until rupture takes place, I feel confident that, in at least 50 to 75 per cent, a tentative diagnosis can be made before rupture. Of course, this condition and a subacute pelvic infection are very frequently confused.

Uterine tumors are no longer an unknown quantity. Rarely now does the operator open and close the abdomen without removing the tumor. We older men well remember how often such a case was sent back to the ward as inoperable.

We are thoroughly familiar with the various stages of the growth of these tumors and have an adequate knowledge of their histology. We also know that some of them may become sarcomatous, and consequently take this factor into careful consideration when deciding when and when not to operate.

What a surgical triumph has already been accomplished in that dread disease—cancer of the uterus. Formerly all died, now some clinics show 25 per cent of recoveries over a five-year period in patients operated on for cancer of the cervix, and at least two-thirds of those operated upon for cancer of the body of the uterus have no further trouble from this cause. We must not forget, however, that too many patients with carcinoma of the cervix come too late for operation. Our chief hope for the future lies in early diagnosis—diagnosis at a time when it will still be possible to eradicate the disease.

Ovarian tumors, large and small, benign and malignant, have been carefully studied and their usual method of development noted; consequently, one is able to give an absolute prognosis in some of these cases and a fairly accurate one in others.

In the past some of the large ovarian tumors were so densely adherent that their removal was thought impossible. But now if the operator meets with a multilocular

[1] Read before the Clinical Congress of American College of Surgeons, Philadephia, October 26, 1921.

cystadenoma he knows that its walls are composed of laminated connective tissue and that he can readily peel out the tumor, leaving, with perfect safety, the outer layers adherent to the intestine or to some other abdominal structure. By this simple procedure some otherwise inoperable cases have been converted into relatively easy ones.

The development of the operation for appendicitis stands out above all the rest of our progressive work. As you all know, it may be a most simple operation, or, on the other hand, it may test the skill of the operator to the limit. Fully one-third of the abdominal operations performed in some clinics are for the removal of the appendix, and yet many of us well remember the time when no surgeon ever thought of doing an appendectomy.

The old term "inflammation of the bowel," a condition which was so often followed by peritonitis, is well-nigh forgotten by the present generation. Thousands have been speedily made well and thousands have been saved from an untimely death by prompt removal of the appendix.

Immediate removal of an inflamed appendix, as far as the abdominal cavity is concerned, is analogous to the service rendered to a growing town by an efficient fire department, when a fire has started. In both cases prompt action is necessary to prevent the conflagration from becoming general. What has been accomplished in dealing with appendicitis is without a doubt the most brilliant and far-reaching achievement in abdominal surgery.

Those of you who have never had gall stones have no inkling whatsoever of how much the sufferers from these "thorns in the flesh" owe to the abdominal surgeon.

To wake up from a fairly comfortable night's sleep expecting to do a good day's writing and then a few minutes later have a telephone conversation which irritates you but would not bother a person who is free from gall stones, and then have this moody state persist all day, is enough to corrupt a saint. To bend over the operating table the greater part of the day with the said gall stones gradually forcing their way down into the cystic duct, or to feel a similar sensation when leaning forward in the pew at prayer-time on the sabbath does not tend to increase one's religious fervor.

An all-night ride in an upper berth, a long automobile jaunt, or an indiscretion in diet, mild though it may be, does not fail to impress upon the mind of the possessor of gall stones that man in general, and himself in particular, was born to trouble. I owe much to my good friend, John Finney, who so thoroughly cleaned the sand out of my own gear-box.

Figure in your mind how many more cases of arthritis, how many more ill-natured people and how many more chronic invalids would be with us today, were it not for the development of gall-bladder surgery.

Ulcer of the stomach and ulcer of the duodenum have to a large extent been transferred from the domain of medicine to that of surgery, and the co-operation of physician and surgeon, with the development of newer procedures, is adding, every year, to the comfort and welfare of patients suffering from these lesions.

It is not so long ago that cancer of the stomach was thought to be absolutely hopeless. Now, thanks to the newer methods of diagnosis, the assistance of the X-ray, and especially to the exploratory operation, an increasing number of cancers of the stomach are detected relatively early—at a time when complete removal seems feasible. And even when partial resection of the stomach does not give a permanent cure, at any rate it often adds several years to the life of the patient.

The removal of tumors of the large and small intestine is becoming safer every year, so that many of these patients formerly incurable can now be saved.

The treatment of uncomplicated herniæ now as a rule gives the surgeon little concern and even in those cases in which strangulation has existed for several days the preparation for or the making of an enterostomy at the time of operation often renders the prognosis favorable.

Intestinal obstruction still gives the surgeon much concern, but the preliminary enter-

ostomy, especially in postoperative cases, not only lessens the operator's anxiety but also gives the patient a chance to pull up and renders the probability of a permanent recovery much brighter.

Surgery of the liver has advanced markedly, but our knowledge of what may be accomplished in diseases of the pancreas and spleen still leaves much to be desired.

In the past one surgeon has paid especial attention to the stomach and gall bladder, another has interested himself chiefly in lesions of the lower abdomen, and still another has busied himself with other structures. The sphere of each has increased. We are reminded of several villages in one large compound. They have gradually developed until they have become one city, and the interests of each are so interwoven with one another that the lines of demarcation are only imaginary. In such a case there is nothing for the several units to do but to get together, obliterate all dividing lines, and work as an organic whole.

The orthopedic surgeon, the genito-urinary surgeon, the brain surgeon, and the nose and throat surgeon have each clear-cut lines of activity. But what has been the rule in abdominal surgery? The general surgeon has in large measure confined himself to the upper abdomen, and the gynecologist to the lower abdomen. That was all very well in the pioneer days of surgery when each and all were groping in the dark and hunting for surgical light, but now that abdominal surgery stands on a sound scientific basis, we have a fairly adequate knowledge of what should be done in nearly all of the abdominal lesions.

When you and I are brought face to face with a desperate abdominal condition in our own family on whose arm are we apt to lean most firmly? Surely it will be on the man who, we are confident, is most capable of meeting any emergency in any part of the abdominal cavity, fully realizing that no one can foretell with absolute accuracy just what the exploratory operation will show. If this be the case, and it most certainly is, then it is our bounden duty so to train the coming generation of abdominal surgeons that they will be thoroughly familiar with every nook and cranny of the abdominal cavity and so train them that they will render the best possible surgical service, no matter in what part of the abdomen the lesion may be present.

I never was more graphically impressed with the absolute necessity of knowing the details about the work one has in hand than this summer in the backwoods of Canada. I have a small motor boat that for some reason would not run during our final days at camp last year, but it was thought that half an hour's work in the spring would put it in order.

At the beginning of the summer all attempts to start it were futile. A good mechanic worked for a full day. He then took the engine to pieces. On account of unusually high water in the spring the motor boat, which is always slung up for the winter and has its bow plug removed, had been forced up to the ceiling. Water had readily passed through the plug hole, entered the cylinder through the spark-plug hole, had frozen and cracked the piston. The defect was soldered and the boat started. It soon heated because the pump would not work, and the solder blew out,—a pine needle had gotten into the pump valve. This was removed. The acetylene tank and other appropriate appliances were obtained and the piston was brazed. Still the boat would not go. Finally, a small spring in the fan of the carburetor was inspected, although it had given no trouble in 11 years. It had worn as thin as an old ring and dropped in two. A new spring was put in and the boat has been running smoothly all summer.

How many of us remember somewhat analogous conditions in the abdomen! Sometimes the gall bladder and duodenum have been inspected and surgically treated, and an appendix has been overlooked. In other cases a pelvic condition has received attention but an upper abdominal lesion has been missed. Unless all parts of the mechanism are thoroughly inspected your boat is liable not to run, and your patient may fail to be completely relieved. The surgery of the future will demand an abdominal surgeon thoroughly acquainted with all parts of the abdomen. This does not mean that the

general surgeon will give up abdominal surgery, or that the gynecologist will cease to do plastic work, but it does mean that neither the general surgeon nor the gynecologist will be allowed to practice abdominal surgery until he is capable of handling lesions in any part of the abdomen, should the occasion demand it, and this is impossible unless he receives the adequate preliminary training.

In the future the recent graduate who wishes to become an abdominal surgeon will, of necessity, first get a thorough grounding as an interne in medicine. In the laboratory he will make numerous autopsies, study medical and surgical lesions, and at the same time thoroughly familiarize himself with the relations of all the abdominal organs to one another.

He will spend a certain length of time with the surgeon who now limits himself entirely to lesions of the upper abdomen and will then become an assistant of a gynecologist who will enlighten him as to the proper handling of lesions in the lower abdomen and will also teach him plastic work. While still an interne he will thoroughly familiarize himself with the gross and histological appearances of the tissues removed at operation. After such an apprenticeship he will have in him the making of a real abdominal surgeon. He may become a general surgeon or a gynecologist, but the essential thing is that he will be a surgeon capable of meeting any and all abdominal emergencies.

You and I as members of the Clinical Congress and those of us who are also members of the College of Surgeons should see to it that every man who in future decides to do abdominal surgery should first have a thorough training in every phase of abdominal surgery. It is our duty to the public, it is a duty we owe to ourselves.

THROMBOSIS OF THE OVIDUCAL SEGMENT OF THE UTERO-OVARIAN ARTERY[1]

With Review of the Literature

By FRANK D. SMYTHE, M.D., F.A.C.S., Memphis, Tennessee

SUCH cases as the one I now report must have been of very rare occurrence in the past, or if they occurred at all they were not considered of sufficient importance and interest to warrant their publication in medical literature. The literature on the subject of thrombosis of the uterine artery is confined to one case only, and that case is embodied in this report.

The history of my case, with the objective findings upon examination and the pathology revealed at operation, is so unique and interesting that its publication with the literature on the subject is, I think, fully warranted.

Mrs. N. B., age 26, was admitted to St. Joseph Hospital September 27, 1920, at 9:30 p.m., with a diagnosis of ectopic pregnancy with rupture or abortion. Her chief complaint was severe pain in the left iliac region, extending downward and backward toward the sacrum. The trouble was of 24 hours' duration, and it occurred simultaneously with a leap from an automobile to the sidewalk. The pain was so severe and persistent that the patient had to be carried from the sidewalk to a room in a nearby residence.

The excruciating pain was of short duration though she was not entirely free from discomfort during the night. Twelve hours after onset of trouble a second attack similar in nature, though not so severe, occurred in the same region. It was accompanied by slight nausea, profuse perspiration, and a feeling of exhaustion. The kidneys acted very freely and an unusually large quantity of urine was passed during the night.

The family history was negative.

Patient had had the usual diseases of childhood and lobular pneumonia. In February, 1920, she had an attack of lobar pneumonia, left lung. She does not remember having been sick otherwise, though at puberty her thyroid gland became enlarged and would enlarge somewhat during each period. She experienced no trouble as result of the enlargement of the thyroid. Menstruation began at the age of 12 of 30 day type, regular; duration, 3 days; amount,

[1] Read before Tri-State (Mississippi, Arkansas, Tennessee, Medical Society, 1920.

Fig. 1. Shows the vascular circle of Byron Robinson or the utero-ovarian artery.

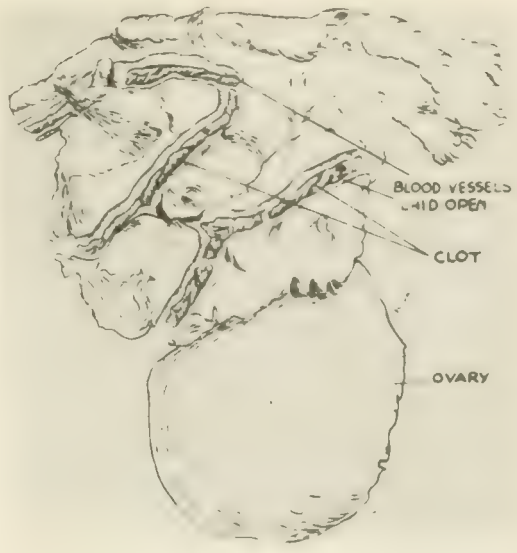

Fig. 2. Drawing made by Dr. Coleman C. Burns of the specimen removed from my patient. It is an exact reproduction of the specimen removed and referred to the pathologist for examination. The position of the clot and the branches of the artery in which the blood clot was situated, and the extent of the involvement are accurately and clearly depicted, and I take advantage of this opportunity to express my appreciation to Dr. Burns for his valued assistance and for the skillful manner in which he executed his task.

moderate, no pain, no clots. She was married at the age of 17 and has three children. Her labors were normal. Two children are living and in good health. One child died a year ago, at the age of 20 months, of whooping cough and enterocolitis. Her last regular monthly period occurred August 5, 1920. On September 20, 15 days after her regular time, she had a hæmorrhage from the uterus. which she considered a return of her monthly period. It was of four days' duration. The discharge was darker than usual, and the quantity somewhat diminished, and a few small clots were passed. There was considerable pain in the pelvis during the progress of the discharge.

Physical examination. Patient is well developed, fairly well nourished, though somewhat anæmic. Eyes and ears are normal. Teeth and gums are in good condition. Neck is normal in appearance with the exception of a horseshoe-shaped scar, the result of an operation performed in 1917 for removal of an enlarged thyroid gland. Breasts are normal, firm, of good size and contain no tumors. Heart and lungs are normal. Abdomen of normal appearance and normal upon examination with the exception of some restriction of motion in the left lower quadrant. Liver and spleen are not palpable. There is tenderness upon pressure and muscular rigidity over the region of the left ovary and tubes. Vulva is normal with the exception of a slight gaping, the result of a tear received during child-birth, which had not been accorded surgical attention. Vagina is normal. Cervix is directed backward and is slightly softer than normal with a laceration on the left side. The body of the uterus is slightly enlarged and the organ is smooth and soft. The right tube and ovary are normal and there is no evidence of pathology situated upon the right side. Situated upon the left side of the uterus is a mass about the size of a hen's egg. The tube is readily palpable and apparently several times larger than a normal tube. The entire mass is movable to a slight extent, and the sensation conveyed to the examining finger is such as would be experienced by coming in contact with a doughy mass.

There was considerable pain produced by the examination.

Blood. Total white count 22,000; differential examination—neutrophiles 88 per cent, small mononuclears 4 per cent, large mononuclears 8 per cent. Malarial plasmodium—absent. Wassermann, negative.

Urine. Examination of specimen showed the urine to be normal.

Pre-operative diagnosis. A pre-operative diagnosis of ectopic pregnancy, left tube, with rupture or abortion was made. The same diagnosis had been made by her attending physician, Dr. Thomas F. Hudson, Luxora, Arkansas.

Operation. A median incision, extending from the umbilicus to the symphysis pubis, was made. Upon entering the peritoneal cavity it was observed that the cavity was entirely free from blood, which surprised us very much as we confidently expected

to find a case of ectopic pregnancy with rupture plus the resulting hæmorrhage. The uterus was larger and more vascular than normal. The right tube and ovary were normal. The left tube was three times its normal size, was greatly congested and very red. The fimbriated extremity was closed though the ostium was not sealed by adhesions. The left broad ligament—especially the organ of Rosenmuhler, was œdematous and very much thickened. The left ovary was about the size of a hen's egg, prolapsed and lying very close to the uterus, on the left side. The left tube and ovary with a good portion of the upper part of the broad ligament was removed and referred to the pathologist with the request that a careful investigation be made in order to determine whether the altered condition of the tissues was the result of ectopic pregnancy, atypical, or hæmorrhage into the tube, in order to ascertain the cause of the œdema of the broad ligament and the enlargement and engorgement of the left tube. The recovery of the patient following the operation was prompt and uneventful.

Pathological Report. Dr. L. V. Schmittou, pathologist, reported as follows:

Specimen which was removed from Mrs. B. consists of left ovary with a portion of the broad ligament. The ovary is enlarged, size of small hen's egg, and contains a large simple cyst. The tube is slightly œdematous and very much congested; the blood vessels appear to be numerous and considerably enlarged. The broad ligament is decidedly thickened and there is an increased amount of dense connective tissue. Section of the ovarian artery, beginning in the thick portion of the broad ligament, shows a blood clot, which can be traced throughout the entire length of artery contained in the specimen. The clot is fairly hard and apparently partially organized.

Diagnosis: thrombosis of ovarian artery and simple cyst of ovary.

I was unable to find the record of a similar case in the literature at my command and began correspondence with the Surgeon General's Office, Washington, and the letter received from Dr. W. B. King, of the Library, is as follows:

"In compliance with your request I have carefully searched the literature of the first, second, and third series of the *Index Catalogue* of the Library of the Surgeon General's Office and find only two references which seem to bear directly upon the subject. In order that you may review this material personally I am having the volumes forwarded to you from the Library, by registered mail, today. I trust you will find them helpful. It would seem that you have a very original condition to report."

Through the courtesy of Dr. King and his interest in the subject, I am able to report the case of Dr. Jacobs, of Brussels, published in the *Bulletin de la Societe Belge de Gynecologie et d' Obstetriques*, September, 1898, page 107, under the title of "Un Case de Thrombose de l' Arterie Uterine." The symptoms of his case, however, as will be observed, were not analogous to those symptoms experienced by my patient, and the objective findings were likewise quite different. The translation of Dr. Jacobs' case follows:

"I wish to put before you an interesting pathological specimen, removed at operation, from a woman 48 years of age. She had undergone curettage for profused uterine hæmorrhage in America at the beginning of the year. The operation was without lasting results and she came to Europe and put herself under our care.

"She is the mother of two children, the youngest of whom is 18 years old. She has been subject for nearly a year to severe attacks of hæmorrhage between her menstrual periods. Previous to that time her menstrual history has been normal as to time and quantity. One year ago, however, her periods became more irregular and the flow more decided, and she consulted a physician and was curetted in February, 1898. She was relieved for a time but the hæmorrhage recurred in April, and her general health at the time she consulted us was precarious. She was anæmic and complained of profuse hæmorrhage from the womb, with severe pain in the abdomen and in the lumbar regions, which radiate to the lower extremities. She was greatly emaciated, with poor appetite, her color was bad, and she was suffering with melancholia.

"Upon examination the neck of the womb appeared to be normal but flowing from it was a quantity of dark blood. The body of the womb was movable, somewhat increased in size and painful upon pressure. The appendages were normal. Considering the depressed condition of the patient and the failure of the curettage to arrest the hæmorrhage, and the fact that her mother had died of cancer of the breast, we concluded that she was affected with cancer of the body of the uterus, so advised total hysterectomy without delay.

"The operation was performed the latter part of July, through the abdominal route, and the operation *per se* was without incident, and a permanent cure from every point of view was effected. She sleeps well at present, her appetite is good, she is free from pain, and is full of life and energy, has regained considerable flesh, and will return to her home in America within a few days.

"The specimen consists of the uterus and its appendages, showing the body of the uterus enlarged and the tubes and ovaries show minor lesions. A section of the uterus shows the mucosa considerably

hypertrophied. Microscopic examination does not show any evidence of cancer. In the right broad ligament we encountered the uterine artery, which was as large as the iliac artery and without sinuosities—thrombosis. The thrombus occupied the vessel to the right cornua of the uterus. At this point the vessel was very large and quite tortuous.

"It will be seen from the dissection that a well-organized thrombosis extends into the branches of the uterine artery (rami laterales) as far as the right cornua, anteriorly and posteriorly. The utero-ovarian artery is somewhat longer than usual. On the left side there is no evidence of any lesion present. The walls of the uterine artery on the right side are thickened and sclerosed. Was that local lesion the cause of the alarming symptoms presented by our patient? We presume so, since we are unable to prove otherwise. There is nothing in the history of the case to suggest the origin of the trouble, actual or possible; nor the length of time that the thrombosis had existed."

My patient was pregnant. It was a case of utero-gestation, of 7 weeks' duration, and not a case of ectopic pregnancy. The history of the case, that is the onset of the affection, the subjective symptoms plus the objective findings, justified the diagnosis of ectopic pregnancy with rupture or abortion, which was not inexcusable. One important subjective symptom, however, found in the history of all my cases of ectopic pregnancy with rupture or abortion was absent in this case, namely, there was no history of pain preceding the onset of hæmorrhage, which the patient experienced 6 days before she was admitted into the hosptial, and 5 days before the development of the trouble for the relief of which she was admitted to the hospital.

The opinion that a patient may suffer rupture or abortion without loss of blood is probably not without foundation in fact, but it is at variance with all of the cases examined and operated upon by myself, and I have grown to attach considerable importance to the history of the case in regard to pain, more or less sudden and severe, as possessing much diagnostic significance.

I am induced to report this case with the literature on the subject for the reason that a mistake was made in the pre-operative diagnosis of a case presenting practically all the classical symptoms, and where the objective findings were such as to justify the diagnosis of ectopic pregnancy with rupture or abortion, but which proved at operation to be a case of utero-gestation with thrombosis of the oviducal segment of the ovarian artery with great thickening of the broad ligament and simple cyst of the left ovary of moderate size.

Errors heretofore committed in pre-operative diagnosis of ectopic pregnancy with rupture or abortion, made by myself, have generally proven at operation to have been cases of hæmorrhage into the tube or into the ovary. Occasionally unilateral pyosalpinx produces symptoms, subjective and objective, somewhat similar to the symptoms of a case of ectopic pregnancy with rupture or abortion, hence an occasional error is made. After summing up all the evidence available, however, generally speaking, the subjective symptoms plus the objective findings point almost unerringly to the source of the trouble in cases of ectopic pregnancy with rupture or abortion, and the painstaking physician is rarely mistaken in the correct interpretation of the pathology responsible for the symptoms complained of. One will be confronted at times, however, apparently with an atypical case in which a correct diagnosis before operation cannot be made.

THE CAUSE OF THROMBOSIS IN THIS CASE

The probable cause of the thrombosis of the artery in this particular case was not determined as the pathologist failed to examine the specimen for bacteria, hence the report so far as the etiology is concerned is incomplete.

Thrombosis of the uterine and ovarian veins resulting from puerperal infections and infections due to instrumentation are not uncommon. Thrombosis of the ovarian artery, however, is very uncommon, if we are to judge their infrequency by the absence of reports of cases in medical literature.

INSUFFICIENCY (EVENTRATION) OF THE DIAPHRAGM[1]

With the Report of a Case and the Surgical Treatment Thereof

By WILLIAM LERCHE, M.D., F.A.C.S., St. Paul, Minnesota

THERE are a number of cases reported in the literature, in which the left half of the diaphragm was found to be in an abnormally high position—up to the fourth, third, or even the second rib, forming a sac-like dilatation into which one or more of the abdominal organs were displaced, especially the stomach, the colon, or the spleen. The left lung occupied a correspondingly smaller space and the heart was usually found dislocated to the right. These cases have been described under various names, such as "paralysis of the diaphragm," "phrenic paralysis," "true hernia of the diaphragm," "eventration of the diaphragm," etc.

Petit (1) in 1790 described the case of a woman, in which at autopsy a sac-like dilatation of the left side of the diaphragm, containing the stomach, the colon, and the great omentum, was found. It was published under the name "hernia of the diaphragm" and is probably the first of its kind recorded.

Cruveilhier (2) in 1849 referring to the work of Petit, cites the case just mentioned, under the name "eventration of the diaphragm."

Although since then the name "eventration" has been in vogue, it has not met with general approval, and various substitutes have been suggested such as "relaxation," "elevation" (hochstand), "insufficiency," etc.

Eventration is not an ideal name for this condition of the diaphragm but on the other hand relaxation can hardly be accepted, as there is a period in the normal excursion of the diaphragm, in which the latter is in relaxation. The same may be said about elevation.

Insufficiency of the diaphragm, however, appears to me a most appropriate name and it would seem less confusing if the affections of the diaphragm described under the various names mentioned above, could be grouped under this according to their etiology.

Insufficiency of the diaphragm may be congenital or acquired.

1. Congential. Meckel (3) in 1809 found in a female fœtus a sac-like dilatation of the left side of the diaphragm, which contained the stomach, jejunum, ileum, cæcum, colon, and the spleen.

Pyl (4) in a newborn found the left side of the diaphragm dilated to a thin sac, containing the stomach, spleen, ileum, and curvatura coli. The heart was displaced to the right.

2. Acquired insufficiency may be (a) acute or (b) chronic. It may follow a lesion of the phrenic nerve between its origin and the end filaments in the diaphragm, or it may be due to the degenerative changes in the musculature of the diaphragm itself.

Barbano (6) cites 38 cases in which degenerative changes of the phrenic nerve following infectious diseases were demonstrated, mostly accompanied by degenerative changes of the musculature of the diaphragm. In two cases the degenerative changes were confined to the musculature of the diaphragm alone, with the phrenic nerve intact. Barbano thinks this nerve more susceptible to the toxic action of the germs than any other nerve.

Quadrone (7) has made similar observations. Such changes in the diaphragm have been observed after influenza, pneumonia, typhoid fever, diphtheria, septicæmia, parenchymatous nephritis, erysipelas, tuberculosis, pericarditis, endocarditis, pleurisy, subphrenic abscess, rheumatic arthritis. It has also been seen after Huntington's chorea and alcoholic neuritis.

Of other causes affecting the phrenic nerve may be mentioned injury, as fracture or luxation of the spinal column, spondylitis, pachymeningitis, spinal hæmorrhage, tumor in the spinal canal, injury to the nerve in the neck, tubercular lymph nodes, and tumors in the mediastinum causing inflammation or compression.

Of changes observed in the musculature of the diaphragm are, pseudohypertrophic lipomatosis, degenerative atrophy, myositis.

[1] Presented before the Minnesota Academy of Medicine.

Fig. 1. *a*. Upper domeshaped outline of the stomach. *b*. Showing barium mixture in the bronchi of lungs.

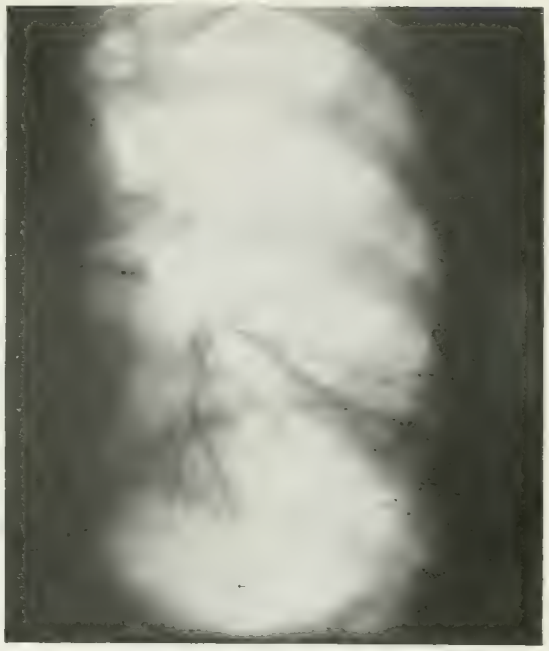

Fig. 2. Barium-filled bronchi extending far below and behind the dome of the stomach. See arrows.

Franck (8) reports a case, in which he considers the insufficiency of the diaphragm brought on by a megacolon causing atrophy by pressure.

Hoffmann (9) thinks that it may be brought about by pressure from a chronic large *magenblase*.

a. Acute insufficiency of the diaphragm. This may follow one of the infectious diseases mentioned above, run a course of a few weeks, and disappear.

In a case of Behrenroth's (10) following influenza, the left side of the diaphragm was found on a level with the upper border of the fourth rib. The heart was displaced somewhat to the right. In the course of 4 weeks the symptoms disappeared and the diaphragm came down to its normal level. The case was reported under the name of paralysis of the diaphragm. The symptoms in this case were sensation of fullness and discomfort in the left thorax with a feeling of heaviness in the heart region and fullness after eating.

Stockton (11) relates the case of a man thought suffering with la grippe. His heart was found transposed to the right, and the upper limit of the stomach was at the upper border of the third rib. Both the heart and diaphragm gradually returned to normal position in the course of a few weeks.

b. Chronic insufficiency of the diaphragm. Under this heading would come the remainder of the cases, in which the diaphragm is permanently disabled. The case that I wish presently to report belongs to this class.

Female, age 37; married at 17; never pregnant. Father had asthma and died a morphine user; mother 61 and well. Two brothers and one sister living and well.

Between the age of 8 and 20, the patient had been troubled with suppurating cervical lymph nodes for which she had undergone several operations. At the age of 25, while at breakfast, a bit of cornflake by accident entered her larynx. She had a violent coughing spell with choking, and had to be carried from the dining room.

After this accident, whenever she took liquids, a part would be coughed up. At times she would regurgitate her food, and sometimes thick mucus. She had never had hæmoptysis or hæmatemesis. Since the accident she has been dyspnœic, and swimming, climbing stairs, or running has been impossible, and she has been unable to lie on her back or right side without a great deal of pain and vomiting. She has also had a great deal of trouble with her stomach—epigastric pain, distress, and vomiting—and has been

Fig. 3. Roentgenogram taken in the horizontal position. Barium mixture filling the fundus of stomach.

laid up in hospitals at various times on that account. Quite recently she had been advised to have an operation for supposed cancer of the stomach.

Examination. Patient is a fairly well-nourished woman with several scars on both sides of the neck. The right lung is normal. The apex beat is not visible, and the heart sound is distant. On the left side of chest there is a tympanitic percussion note from third interspace down in front.

Fluoroscopy. The heart is seen displaced to the right. The right lung is normal. On the left side of the chest is a shadow line with its concavity downward, and its highest point in the third interspace. It is apparently the upper dome-shaped limit of a large gas-filled space (Fig. 1, *a*).

The patient was given barium buttermilk mixture and while drinking, it was observed that a part of the mixture dropped into the trachea, thence into the bronchi on both sides (Fig. 1, *b*), more into the left than the right. The barium-filled bronchi could be seen extending far below and behind the above-described dome of the gas-filled space (Fig. 2). From the lower part of the œsophagus the barium mixture flowed upward to the left, indicating that the cardia and fundus were displaced to a higher level than normal. With the patient in the horizontal position, the barium mixture filled out the dome-shaped space to the third interspace (Fig. 3) and in Figure 4 both the stomach and the colon are seen in the sac.

Fig. 4. Showing both the stomach and colon in the sac.

Œsophagoscopic examination. An opening was seen about 19 centimeters from the incisor teeth, on the anterior wall of the œsophagus, somewhat to the left. A probe could be introduced through this opening into the trachea.

About 38 centimeters from the incisor teeth the œsophagoscope met an obstruction preventing it from entering the stomach. It was evident that the œsophagus took a turn upward and to the left. In order to demonstrate the angle in the lower end of the organ a simple contrivance was devised. A stout string was pulled through a long soft, rubber tube (tubing used for cigarette drain), and fastened to a cork stopper, which closed the one end of the tube. The tube was then filled with thick barium mixture, and when the patient swallowed it, while observations were made through the fluoroscope, it was seen that it turned upward into the fundus at a more acute angle than is seen in the roentgenogram (Fig. 5). From this observation and the œsophagoscopic examination, it appeared as if the abdominal part of the œsophagus was quite sharply flexed.

Bronchoscopic examination. An opening was seen about 19 centimeters from the incisor teeth, on the posterior wall of the trachea, somewhat to the left, which communicated with the œsophagus.

It was at once apparent that we had an œsophago-tracheal fistula to deal with, (Fig. 6) but as to the

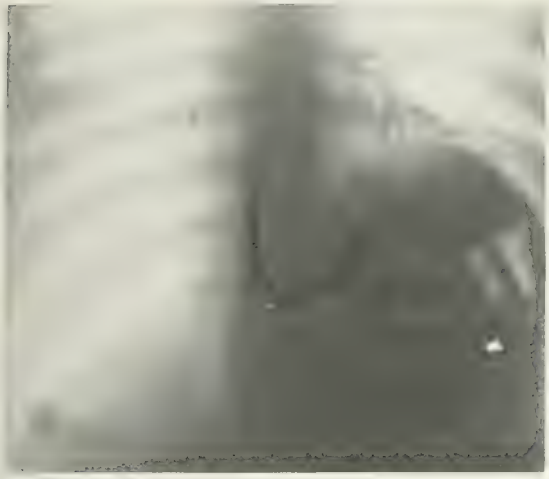

Fig. 5. Soft rubber tube filled with barium mixture showing the lower end of œsophagus flexed upward to the left.

rest of the pathology, after everything else had been excluded, it was extremely difficult to make a differential diagnosis between "insufficiency of the diaphragm" and hernia of the diaphragm.

In favor of a diagnosis of "insufficiency" was the complete regularity of the contour of the dome or the upper shadowline.

A point in favor of "hernia" was that the lung tissue with the barium-filled bronchi could be seen through the gas-distended stomach. There was practically no movement of the shadow line.

In some of the roentgenograms taken after barium mixture had been swallowed, there was the broad streak of a barium shadow crosswise at the level where the diaphragm would normally be, which could be interpreted as a fold of the stomach lying on the diaphragm and containing the small pool of barium mixture (Fig. 7).

We were in favor of a diagnosis of "insufficiency" but the roentgenograms just mentioned made it questionable.

The patient naturally was very anxious to have the œsophagotracheal fistual repaired, but it was out of the question to attempt that until the condition of the diaphragm had been corrected, because most of her suffering was due to the insufficiency of the latter.

It was therefore planned to repair the diaphragm whether insufficiency or hernia, and to pleat it if it proved to be a case of "insufficiency."

Operation. An incision through the outer part of the left rectus muscle with the addition of a cross incision of the rectus in the upper end, gave good access to the diaphragm. The presence of an insufficiency of the diaphragm was demonstrated, the sac-like dilatation containing the stomach and part of the colon. The stomach was found rotated, the larger curvature pointing directly forward. The latter finding probably explains the vomiting and

Fig 6. The arrow points to the œsophagotracheal fistula.

pain when the patient attempted to lie on her right side—the greater curvature perhaps deviating still further to the right, causing acute angle in the pyloric part.

After packing off the liver, stomach, and bowels with large swabs, the diaphragm was pulled downward and forward by grasping it on the posterior wall high up with a long curved forceps. This fold was then sewed to the diaphragm near its attachment to the anterior wall with interrupted chromic catgut and reinforced by silk sutures from left to right extending a little beyond the mid-line. Another fold was brought down and sewed further forward in a similar manner, as shown in Figure 8. In the thumb sketch is shown another method of sewing the diaphragm.

The explanation of the origin of the œsophagotracheal fistula is probably that suppurating lymph nodes in the groove between the œsophagus and trachea had partly ulcer-

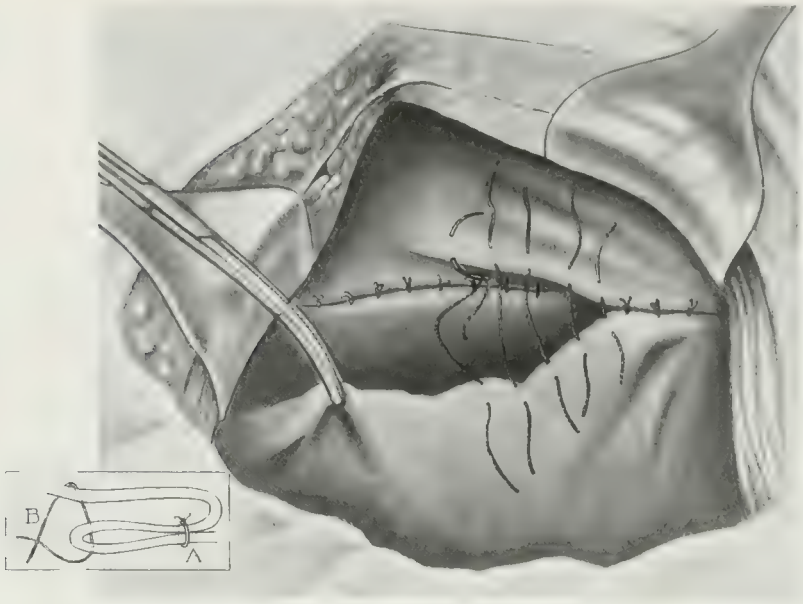

Fig. 8. Author's method of sewing diaphragm.

ated through the walls of these organs and the pressure from the violent coughing spell was sufficient to rupture the remaining part of the walls. The phrenic nerve had likewise probably also been involved by the infected lymph nodes in the superior mediastinum and the coughing spell probably aided in bringing about the condition of the diaphragm.

It is of interest to note that the important sign mentioned above, on which much stress has been laid in the differential diagnosis between hernia and insufficiency, failed; namely "when lung tissue can be seen through the gas-filled stomach, it is a point strongly in favor of hernia." It can readily be seen how this added to the difficulty in making the differential diagnosis in this case, and it means that the value of this sign must be taken *cum grano salis*.

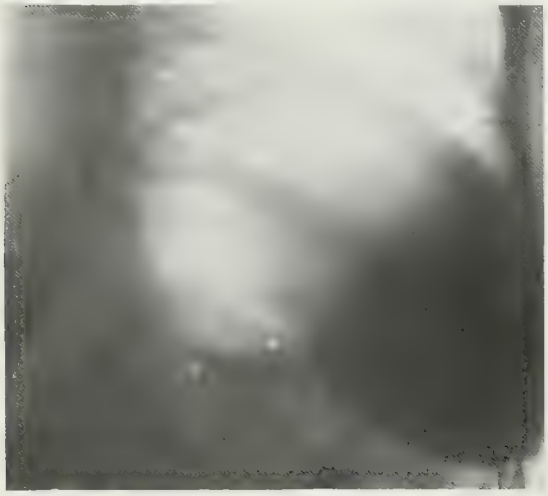

Fig. 7. Arrow points to the barium shadow at a level where the diaphragm would normally be.

Fig. 9. Position of diaphragm 11 months after operation.

As to the value of this operation, whether it will be permanent or not, I cannot say. As far as I know it is the first attempt to correct insufficiency of the diaphragm surgically. It has hitherto been considered a non-surgical condition.

The patient made a prompt recovery and left the hospital in less than 3 weeks. There was a little effusion into the left pleural cavity but after the operation this very soon disappeared.

Seven months after the operation the patient is so well that it may be unnecessary to attempt the repair of her œsophagotracheal fistula, because she has now hardly any cough, she has no digestive symptoms, she can lie on her back or her right side with perfect comfort, she has gained in weight and she is able to work.

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THE CHOICE OF OPERATION IN INGUINAL HERNIA

Based upon the Type and Position of the Sac

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HERNIOTOMISTS attach varying degrees of importance to high ligation of the sac and firm reconstruction of the inguinal canal in effecting permanent cure of inguinal hernia. Most agree that in infancy high ligation alone suffices, little or no deliberate effort at reconstruction being made. All agree that in adults not only must high ligation be done, but the canal must be reconstructed with meticulous care to form a strong bulwark against recurrence. This difference of procedure according to the age of the patient is, of course, based mainly upon the state of the tissues in the young and in the old. In the young the sac is present because the funicular process (in some cases the entire processus vaginalis) was not obliterated, the muscular mechanism of the canal being normally developed, the muscles themselves supple and resilient. In the old, on the other hand, while the sac may have existed in a more or less empty state since birth, yet it is often acquired under stress and strain which the muscular mechanism is unable longer to resist. The sac grows larger as the muscle tissue, no longer so supple and resilient, recedes before it. Congenital deficiency of the conjoined tendon is an important predisposing factor in this group, and will be referred to later.

In a paper[1] read before the Medical Society of the State of Pennsylvania in 1917, the author presented his views on the operative treatment of inguinal hernia in young, muscular adolescents with thin, empty, non-adherent sacs—the type usually encountered in lads coming up for enlistment. Most of these subjects were unaware of the presence of a hernia until their attention was called to it by the medical examiner. Physical examination usually revealed a slight fulness in the scroto-abdominal passageway, such as would be caused by a thin sac of small caliber with, perhaps, a narrow, non-adherent tongue of omentum; in fact, operation disclosed just these findings. After high ligation and division the stump of the sac disappeared from view underneath the border of the internal oblique muscle which, when the patient strained (the operations having been performed under local anæsthesia), in conjunction with the well-developed conjoined tendon and rectus, satisfactorily approximated Poupart's ligament, narrowing the hernia triangle to practically the same extent as in subjects without hernia; in other words, the canal musculature was functioning physiologically without the aid of the surgeon. For this reason the author did not deem it necessary to reconstruct the posterior wall of the canal (hernia triangle), resting content with closing the cremaster and perhaps imbricating the external oblique aponeurotic flaps. This technique, however, was used only in this type of selected case. No recurrence followed as far as the author is aware.

This long, narrow, thin, empty, non-adherent sac is congenital and represents an unobliterated funicular process. For the purposes of this article we will call it a stalked sac, in contrast to a sessile sac, which will be taken up later. Such a stalked sac encountered in early life, adolescence, or in a recent hernia in well-muscled adults calls for high ligation without reconstruction of the posterior wall of the inguinal canal, the internal oblique muscle in these cases usually being found well developed and wholly capable of fulfilling its physiological function of narrowing the hernia triangle during strain. In old, indirect herniæ with a large sac, on the other hand, we have an entirely different proposition to deal with, for here the canal musculature has been overstretched and weakened by long-continued drag of the sac with its heavy contents. The sac, though still stalked, approaches the sessile type; it must be ligat-

[1] Pennsylvania M. J., 1918, xxi, 627.

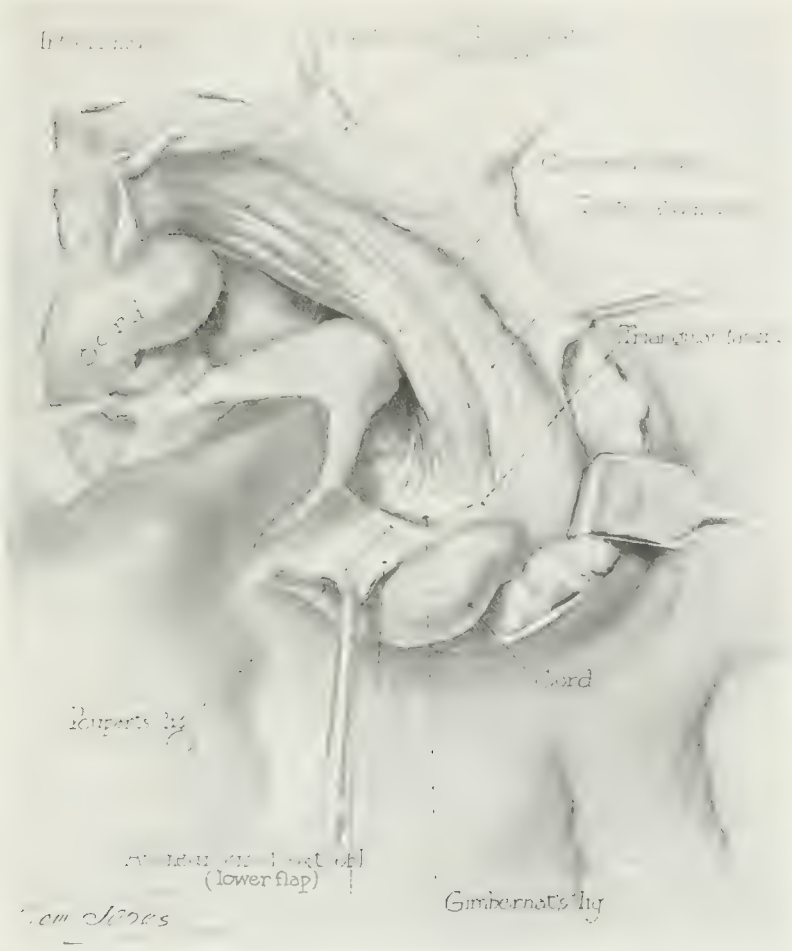

Fig. 1. Inguinal canal laid open, cord retracted, gauze-covered index placed in hernia (inguinal) triangle and pushed against lower border of conjoined tendon until there develops a stout, finger-like cylinder of aponeurosis-covered musculature which is to be sutured to Gimbernat's and Poupart's ligaments.

ed high and, in addition, the posterior wall of the inguinal canal must be carefully and stoutly reconstructed.

Now let us consider the sessile type of sac. The purest example of this type is found in the condition that has been described as "diastasis of the external oblique aponeurosis." Here one sees on inspection a low, oval bulging just to the outer side of the external ring and usually on both sides. On palpation it is easy to introduce three fingers through what seems to be a cleft in the external oblique aponeurosis, and usually the fingers can palpate the pubic bone, space of Retzius and posterior surface of the pubic head of the rectus muscle; when the patient strains the fingers are "bitten" between the contracting boundaries of the hernia triangle. Operation discloses an actual cleft in the fibers of the external oblique aponeurosis, usually continuous with the external ring and extending from it laterally 3 to 5 centimeters: it is what the practitioner refers to as "relaxed" or "dilated" ring. The low, oval bulging is due to protrusion of the internal oblique muscle through the cleft in the external oblique

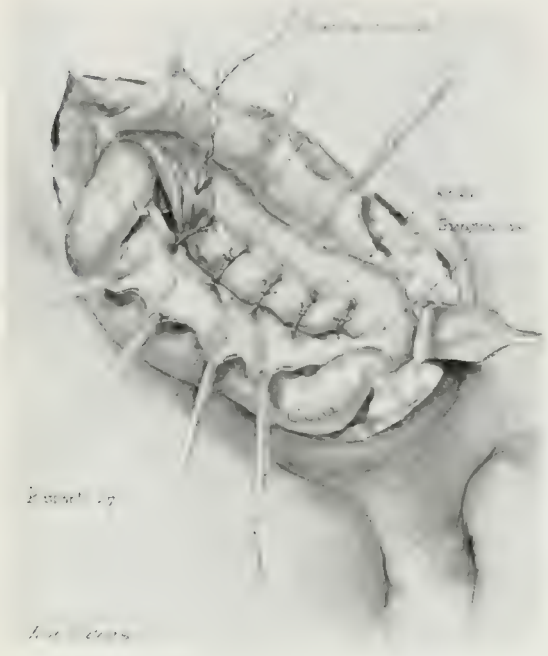

Fig. 2. The stout, finger-like cylinder is sutured to Gimbernat's then to Poupart's ligament, using interrupted sutures of No. 2 chromic gut, doubled and carried by a small, full-curved, non-cutting needle. The innermost suture is inserted just to the outer side of the triangular fascia into the lowermost portion of the linea semilunaris, including in its bite a thickness of the aponeurosis-covered rectus head about equal to that of the little finger and, below, an area of Gimbernat's ligament of corresponding breadth. The remaining sutures are passed in the same manner until the cord is reached, the tissues included in their bite varying in name, but not essentially in structure, although the outermost usually encounters muscle tissue of internal oblique instead of aponeurosis.

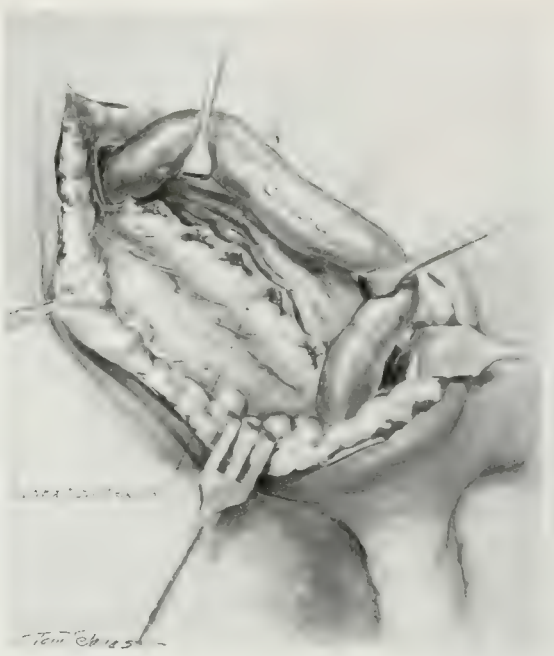

Fig. 3. Interrupted sutures of single-thread No. 2 chromic catgut tack lower flap of external oblique aponeurosis down upon finger-like cylinder. The innermost passes close to outer pillar of external ring. Each stitch takes in its bite a portion of the cylinder situated between two deep sutures. A nick for the passage of the cord is made in the lower flap beyond the last suture. The effect of this row is to grip the cylinder and retain it in contact with Gimbernat's and Poupart's.

aponeurosis, and necessarily, the transversalis fascia and peritoneum follow in the wake of the internal oblique. There is scarcely, however, a hernial sac—merely an incidental sessile protrusion of the peritoneum; therefore, one is not justified in calling this condition a hernia. In the presence of ascites the bulging becomes much more pronounced. The treatment advocated for this condition is not that for hernia, but consists in suturing the upper edge of the lower flap of external oblique aponeurosis to the linea semilunaris, imbricating the upper flap over the anterior face of the lower. No attempt at developing a hernial sac to ligate is made, in fact, the deeper structures are ignored.

The "diastasis" above referred to may or may not be considered a predisposing factor in the development of direct hernia, but it is at least somewhat akin to the next condition I wish to consider, namely, a defect in the next layer, the internal oblique muscle and conjoined tendon. When defective this layer is thinned out and fails to reach its normal insertion into the pubic bone, its lowermost fibers inserting into the linea semilunaris. Here, again, there is an incidental bulging of the transversalis fascia and peritoneum, the latter forming a "sessile" protrusion which, when bulking large, differentiates itself as a direct hernia. Here, as in the diastasis, it seems quite as logical to ignore the sessile protrusion, reconstructing the layer at fault—the conjoined tendon. As a matter of fact, Masson advocates not opening the sac in direct hernia, unless the sac is large, but simply

Fig. 4. The upper flap of external oblique aponeurosis is tacked down upon the lower flap, using same type of suture. The innermost passes close to inner pillar of external ring. Mattress sutures may be used here. A stitch may be needed to the outer side of the cord. Note how at this point the internal oblique muscle fibers form a soft cushion for the cord, preventing constriction of latter. This row of sutures supports the second row, further tightens the canal and effects imbrication of flaps of external oblique aponeurosis. The next sketch will show how it also supports the first line of sutures, though not so directly.

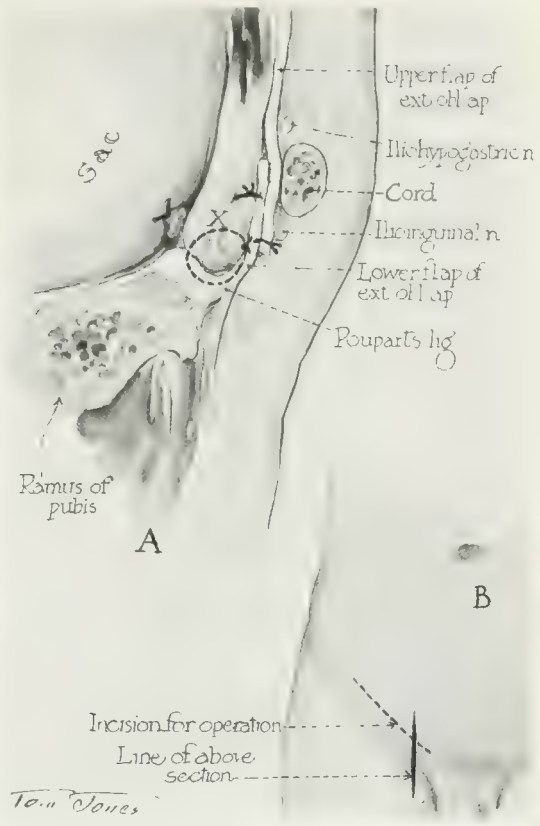

Fig. 5. Orientation of sutured structures in sagittal section. Note stout finger-like process jammed down upon shelving ledge by first suture row; how second suture row helps hold it down in place through agency of short lower flap of external oblique aponeurosis, and how third suture row accomplishes the same purpose through agency of longer upper flap. A strong buttress against recurrence has now been established. The two nerves may be carried to the surface of the external oblique aponeurosis where internal oblique muscle contacts with outer surface of cord (see Fig. 4), thereby avoiding compression neuralgia.

turning it in with its covering of preperitoneal fat, placing a few stitches in its base. I have of late even avoided opening the sessile sacs of fairly large direct herniæ believing that reconstruction of the defective posterior wall is the essential factor in this type. Why is it a direct hernia seldom or never becomes scrotal? Because the sac is sessile, the pressure therefore more evenly distributed, and the fundamental factor is not the presence of the sac, the protrusion of which is merely incidental, but the yielding buttress—the defective conjoined tendon. Instead of passing downward the sac tends to spread laterally, in the direction of the yielding lateral angle of the hernia triangle, passing beyond the deep epigastric vessels to form a sack of the "pantaloon" type. How different these conditions are from those in our first proposition—the thin, narrow, elongated stalked sac of funicular process, with well-developed, supple, and resilient musculature!

OPERATION

The steps of the operation are well shown in the accompanying illustrations by Tom Jones. A few details will be added.

Incision. The incision is made parallel with the fibers of the external oblique aponeurosis, which is determined by projecting the long axis of the external ring lateralward, the position of the ring being found by pal-

Fig. 6. Note obliteration of dead spaces by suturing edges of deep layer of superficial fascia down upon external oblique aponeurosis. This step also approximates skin edges and after healing has occurred prevents spreading of cutaneous scar. Five or six interrupted sutures may be used instead of the continuous. The suture material is No. 1 plain catgut.

pation with two fingers. When splitting the fat, care should be taken not to open into a superficially situated sac, which may be present with or without an ectopic testicle, nor to injure a superficially transposed cord in recurrent hernia. The superficial blood vessels are carefully ligated with No. 00 plain catgut. The incision is not, as a rule, prolonged beyond the pubic spine, lest scar contracture should occur. The deep layer of the superficial fascia in divided and reflected below to its attachment to the fascia lata; above to the linea semilunaris, while toward the pubic spine it is freed from the cord and its coverings. In recurrent hernia this layer is best separated by beginning well laterally in normal tissue and working medially to the point where it begins to be involved in the scar tissue and then dissecting it from the external oblique aponeurosis.

The external oblique aponeurosis is split parallel with its fibers in such a way as to enter the lateral angle of the external ring; the lower flap is cleaned to the very edge of the shelving portion of Poupart's ligament and to and including Gimbernat's ligament; the upper flap is cleaned to the linea semilunaris, and the triangular fascia is well defined. Each nerve encountered is transferred to the surface of its corresponding flap. The cord with its coverings and with the sac is now picked up between the thumb and index opposite the pubic spine and free to the internal ring. The cremaster muscle with its fascia is split and reflected from the cord and sac as far as the internal ring and in old, large herniæ is removed completely, so that the aponeurotic structures are brought out clearly and cleanly, as shown in Figure 1. In small, recent herniæ the cremaster may be preserved and when closing sutured as a separate layer. A lipoma, if present, is completely ablated. The sac is now picked up and freed from the cord and infundibuliform fascia clear up to the internal ring. At this point the vas is usually adherent to the inner portion of the sac, there is dense fat which is not easy to separate from the sac, and the infundibuliform fascia is thick and must be separated from the sac in order to effect ligation of the latter high up in unstretched peritoneum. The sac is emptied of its contents before it is opened, if possible and if non-adherent, and when difficulty is encountered in preventing the contents from re-entering the sac a small pair of rubber-covered intestinal forceps is applied to its neck while the sac is being ligated. The sac is transfixed by a non-cutting needle carrying a strand of No. 2 chromic catgut, which is then tied on each side. The sac is removed one-third inch distal to the ligature. The writer does not practise anchoring the stump of the sac. In hernia of the direct type the sac is seldom opened and ligated, but merely pushed back. In all cases of this type, however, an extension of the sac lateral to the deep epigastric vessels is looked for. This is done by exerting a little traction on the spermatic vessels, and now and then a little sac will be revealed at the internal ring, which is one leg of the "pantaloon" sac of the direct-indirect type of inguinal hernia, and which if overlooked may give rise to recurrence of the

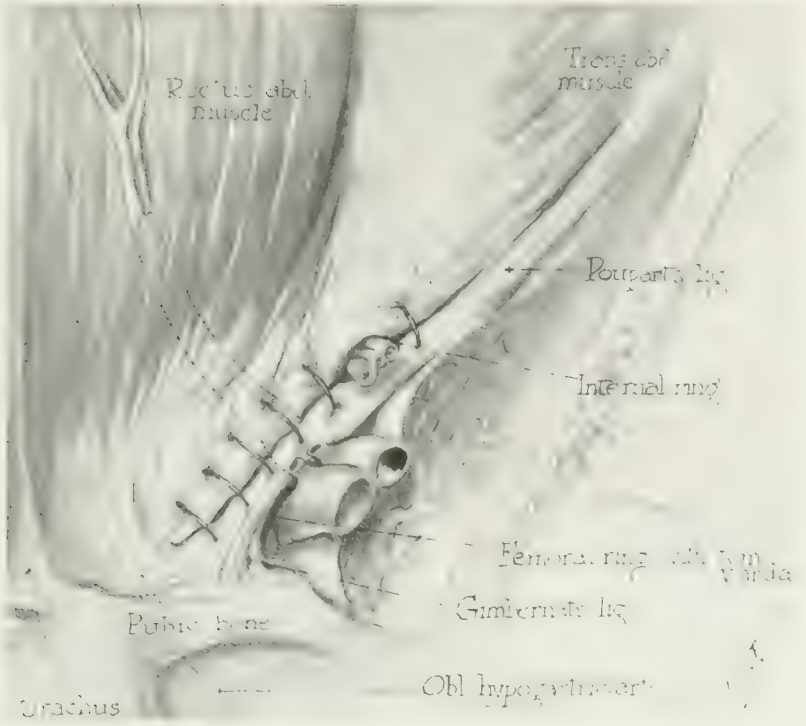

Fig. 7. Orientation of operation field from abdominal cavity. Note great strength imparted by first suture row to that portion of abdominal wall between pubic bone and internal ring; also note lateral displacement of internal ring.

indirect variety. Recurrence of the direct type following operation for indirect hernia, which sometimes occurs, is hardly possible if the hernia (inguinal) triangle is obliterated in *every* inguinal herniorrhaphy, which is accomplished in the author's technique.

In operating upon recurrences the writer has noted the weakness of the tissue layer (internal oblique and conjoined tendon) which was sutured to Poupart's ligament. It seems that in many cases this layer, which is employed in the Bassini technique, is so thinned out and atrophied as to be practically useless as a barrier against recurrence. This thin layer may be scraped away with a piece of gauze until aponeurosis alone remains as the covering of the finger-like cylinder, or else it may be curled under when the latter is brought down to Gimbernat's and Poupart's ligaments.

The posterior wall is now reconstructed as the illustrations show, and the legends describe. The writer does not consider nearly as strongly opening the rectus sheath and bringing down the muscle fibers, or throwing down a flap from the rectus sheath as taking the rectus in its unopened sheath (linea semilunaris); nor has he encountered the tension difficulty of which Torek complains in obliterating the inner (pubic) angle of the hernia triangle.[1] The latter is effected by No. 2 chromic catgut doubled, and when this suture is tied it may cut through the anterior rectus sheath a distance of about one-eighth inch, whereupon it is checked by the thickness and resistance of the musculo-aponeurotic tissue compressed by it. While this first suture is being tied the next suture is held taut to share the tension with the first and so on out to the last. As each suture is tied care is taken lest soft tissue from beneath should pout up and interpose itself between

[1] This tension difficulty may largely be overcome both during and after operation by the postural method advocated by Lyle

the approximating aponeurotic surfaces, thereby interfering with satisfactory union. The bulging soft tissue ("sac" of a direct hernia; thin edge of internal oblique or conjoined tendon) may be kept back out of the way, until all the sutures have been tied, by the finger, the bowl of a small spoon, or a small gauze sponge, which is gradually withdrawn laterally as each suture is tied. The outermost suture is tied so as to displace the cord somewhat lateral to the internal ring, as suggested by Pólya, and as is well shown in Figure 7, resulting in the strengthening of an otherwise weak area. The effect of this first row of sutures is to establish a very strong bulwark against recurrence—a bulwark that extends from the pubic crest to beyond the normal position of the internal ring. This bulwark is established in all varieties of inguinal hernia—indirect, direct, or direct-indirect ("pantaloon" sac), with the exception of the funicular process of children and adolescents, referred to above. In those of advanced age with massive scrotal herniæ as well as in those who have been operated upon several times for recurrence one should not hesitate, provided consent has been obtained, to resort to the very ancient practice of orchidectomy, in order to obtain tight and complete closure of the hernia cleft, although in some cases ablation of the cord and its tunics with preservation of the vas and deferential vessels suffices.

The next step consists in imbricating the external oblique aponeurosis flaps, as shown in the illustrations. This imbrication strengthens the first row of sutures in three ways: the lower flap takes the tension off that row directly, through the agency of the narrow strip of the flap between its sutured edge and Poupart's ligament; the upper flap acts less directly, through the agency of its attachment above to the underlying anterior rectus sheath; while both flaps where imbricated resist push from behind. The cord is not interposed between these flaps, for it prevents their agglutination: it is placed on the surface of the imbricated flaps, to which objection is more theoretic than real, for the cord in its final resting place is still covered by the fairly strong, deep, fibrous layer of the superficial fascia, the more or less thick fatty superficial layer and the skin.

SUMMARY

The type of sac is a determining factor as to whether the posterior wall need be reconstructed. The stalked sac, when long, narrow, thin, non-adherent and representing an unobliterated funicular process, such as is encountered in early life, adolescence, or in a recent hernia in well-muscled adults, calls for high ligation without reconstruction of the posterior wall, the internal oblique muscle usually being well developed and capable of withstanding strain. The sessile sac, on the other hand, such as is found in direct hernia, need not be ligated, merely turned in, but reconstruction of the defective posterior wall is the essential factor in this type. In old, indirect herniæ the canal musculature has been overstretched and weakened by long-continued drag of the sac with its heavy contents. The sac, though still stalked, approaches the sessile type, must be ligated high, and the posterior wall must be carefully and stoutly reconstructed. A "pantaloon" sac must not be overlooked in any hernia operation.

The essential features of the operation practised by the author are free exposure and thorough cleaning of Poupart's ligament, Gimbernat's ligament, the triangular fascia, the pubic head of the rectus enclosed in the linea semilunaris, the linea semilunaris itself and the aponeurosis extending laterally from it; firm reconstruction obtained by developing a finger-like cylinder of the musculo-aponeurotic tissue just mesial to and above the thinned-out conjoined tendon and internal oblique muscle fibers, suturing this cylinder to Gimbernat's and Poupart's ligaments from the pubic bone to beyond the internal ring, fastening the lower flap of external oblique aponeurosis down upon the cylinder and the upper flap down upon the lower, thus imbricating the two flaps and taking the strain away from the first row of sutures; bringing the cord out somewhat lateral to the internal ring, preventing constriction of it and transposing it to the surface of the imbricated external oblique flaps; and finally obliteration

of dead spaces by suturing the edges of the fibrous deep layer of the superficial fascia to each other and down upon the imbricated external oblique aponeurosis. The postural method advocated by Lyle, which relieves tension both during and after the operation, should be practised.

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THE FAMILIAL OCCURRENCE OF UNDESCENDED TESTES

Report of Six Brothers with Testicular Anomalies

By BUDD C. CORBUS, M.D., F.A.C.S., and VINCENT J. O'CONOR, M.D., Chicago

THE occurrence of undescended testes in from one to three members of the same family is a matter of repeated record in the more early medical literature. More recently, with our added knowledge of the embryological and anatomical changes which are undergone in determining the development and descent of the testes, the question of hereditary influence and the record of familial occurrence have been given but slight attention by writers on this subject.

This report is made for the purpose of recording a very unusual instance in which we have studied this developmental anomaly in six brothers, all sons of the same father and mother.

Family History. Mr. and Mrs. S. were born in southwestern Russia. The previous family histories of these individuals are very indefinite, but they state positively that there was no known blood relationship between them. They were married at the ages of 19 and 17 years respectively. They came to America shortly after marrying, and for the past 36 years have lived in Chicago.

Mr. S., the father, was a well-developed, hard-laboring merchant. His habits and general routine of life appear to have been normal. He had no known developmental anomalies. Both of his testes were completely descended: he had never had an inguinal hernia; his sexual history was normal. Five years ago he contracted pulmonary tuberculosis following pneumonia and, after a lingering illness, died 2 years ago.

Mrs. S., the mother, is a well-developed woman of 53 years. She has always been well. Her menstrual history is normal and an uneventful climacteric was passed 3 years ago. She has had no miscarriages or stillbirths. She has no developmental anomalies.

There are 8 children, 6 boys and 2 girls, and all are living.

1. Julius S., age 30, restaurateur. His general health is normal. He has a very light beard over the face and moderate hirsutes on his body. His voice is of normal quality. He was married 3 years ago, but his sexual relationship with his wife proved unsatisfactory so a divorce was agreed upon after 1 year. At this time a condom specimen contained no spermatozoa. He has only a very occasional sexual desire.

Local examination. The scrotum is undeveloped, the right testis is entirely absent and can not be found in scrotum, perineum, or groin. The right inguinal ring is tightly closed and there is no inguinal canal. The left testis is in the left inguinal canal and is firmly fixed in the upper portion. The testis is about one-third the normal size and very

Fig. 1. Julius S.

soft. There is a slight relaxation of the inguinal ring on this side.

Right intra-abdominal testis, left undescended testis.

2. Harry S., age 28, newsdealer; has always been well, has never been married. He has no sexual desire at any time. The voice is of a high falsetto quality. Hirsutes and general bodily development are normal.

Local examination. Left testis is fully descended and appears to be normal in every respect. Right testis is the size of a kidney bean and lies very high up in the inguinal canal. There is no apparent relaxation of the abdominal ring on either side. He has no discomfort from the position of the right testis.

Right undescended testis, normal left testis.

3. Sam S., age 26, athletic instructor; always been well except for "fever" at the age of 3 years which left him deaf and dumb. He has normal hirsutes and bodily development. He has had frequent ocitus since the age of 15 years, contracting gonorrhœal urethritis on two occasions. He has been married to a deaf-mute for 2 years and sexual relationship is satisfactory. His wife is now 7 months pregnant.

Fig. 2. Harry S.

Local examination. The scrotum is undeveloped. The right testis is high up in the inguinal canal and is the size of a small pecan. It is fixed firmly and very soft. The left testis is in the middle of the inguinal canal and is the size of a cherry. There is no relaxation of the abdominal ring on either side. Patient claims he has never had any discomfort from the abnormal position of either testis.

Left undescended testis, right undescended testis.

4. Louis S., age 24, mechanic, has had good health always. Sexual history normal. He has been married for 2 years. His wife is said to be now 4 months along in pregnancy. Voice, hirsutes, and bodily development are normal.

Fig. 3. Sam S.

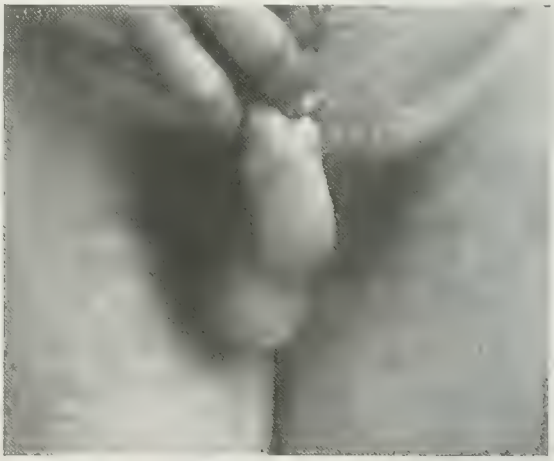

Fig. 4. Louis S.

Fig. 5. Leo S.

Fig. 6. Morris S.

Local examination. The right testis is normal and fully descended. The left testis is situated high up in the left inguinal canal, and is the size of an almond. There is no relaxation of the abdominal ring on either side. There is no discomfort from the abnormal position of the testis.

Normal right testis, left undescended testis.

5. Leo S., age 13, is in the fifth grade at grammar school. He has not yet attained puberty. He is well developed and apparently normal in every way.

Local examination. The right testis is normal in every respect and fully descended. The left testis is in the mid-portion of the left inguinal canal and is slightly movable. It is very small, soft, and not painful on pressure.

Normal right testis, left undescended testis.

Operation for transposition was advised but the mother refused.

6. Morris S., age 8, is very backward mentally. He has a short, thick, fat body and cretin-like facies.

Local examination. The left testis is normal in size and is fully descended. The right testis is the size of a hazelnut and is just above the external abdominal ring. It is freely movable in the inguinal canal, but it can not be forced below the external abdominal ring. There is apparently a co-incident indirect inguinal hernia on this side.

Operation for transposition of testis and repair of hernia was refused by the mother.

Right undescended testis, right inguinal hernia. Normal left testis.

Daughters:

Elsie S., age 19, shop girl, is apparently normal in every way. She is a graduate of a grade school, is intelligent and well developed.

Alice S., age 17, shop girl, was very backward in school only completing the fourth grade at the age of 15 years. She is tall and very thin for a girl of her age. She is very shy and never associates with other girls or with boys. She has marked hirsutes over the chest, neck, and pubis although she has never menstruated. Her voice is bass and harsh in character. Abdominal examination negative.

Godard (1) was the first to point out the familial occurrence of undescended testis. He reports the case of a medical student, 24 years of age, in whom the left side of the body was less well developed than the right, and the left testis fixed high up in the inguinal canal. The father was a monorchid but a brother born of another marriage had normal testes.

Gosselin reports a left undescended testis present in three successive generations. The individual in each instance was an only son.

Kocher (2) believed that retention of the testes is hereditary in many cases.

Goubaux and Follin (3) report numerous instances of the familial occurrence of undescended testes in domestic animals.

Casper (4) believes that retention of the testes is due to an arrest of development which may be due either to hereditary influences or to fortuitous conditions, such as peritoneal adhesions.

Katzenstein (5) operated upon a boy, whose uncle had unilateral cryptorchism. In this instance there were two brothers with the same condition, and in their ancestry there were two cases of cryptorchism.

Schoenholzer (6) believes that the familial occurrence is much more common than is generally supposed because the patients do not like to tell of the condition, and it is seldom that a son knows that his father is a cryptorchid.

The importance of a careful investigation of the family history and a routine examination of the external genitalia of every individual presenting himself for examination can not be overemphasized. It is only by adhering to a routine questionnaire and a careful general investigation of the patient that we will be able to record the actual frequency of the familial occurrence of such anomalies.

Bichon (7) observed undescended testes in three generations.

Buedinger (8) mentions several instances of the familial occurrence of the anomaly. He states that, of the causes given for uncomplicated non-descent of the testes, only two can be accepted; heredity and peritoneal adhesions.

Klein (9) reports an instance where the brother of a monorchid had multiple dystrophies, particularly hypospadias.

Kellnerr (10) made a comprehensive study of 558 boys in an institute for the weak minded and found anomalies so frequently that he concludes that retention of the testis is a biological stigma of degeneration. This statement is, indeed, an extravagant one and does not seem at all warranted by a review of the literature.

As far as we are able to determine the family included in this report embraces the most unusual occurrence of this anomaly on record.

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CARCINOMA OF THE BLADDER WITH BONE METASTASES[1]

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THAT malignant tumors of certain organs have a tendency to produce bone metastases is an old and well recognized clinical fact, and it is generally believed that carcinomata of the prostate, the breast, and the thyroid, as well as hypernephromata, are the most frequent of the malignant tumors which produce bone metastases.

On the other hand, carcinomata of the uterus and stomach rarely exhibit this phenomenon. To this group may be added carcinomata of the bladder. That this assumption is universally held is justified by the facts that the subject of bone metastasis in carcinoma of the bladder receives little or no attention in the various textbooks on genito-urinary surgery and that the literature shows but a few isolated case reports.

Moore, in a study of 65 cases of metastatic malignancy of the bones, found the primary growths as follows: breast, 36; prostate, 11; kidney, 7; thyroid, 7; vulva, 1; sigmoid, 1; uterus, 1; abnormal masses of unknown origin, 3; and primary source not discovered, 3. No case of carcinoma of the bladder producing bone metastasis is found in this series of 65 cases. Geraghty, however, states that bone metastasis is common in cases of carcinoma of the bladder and Zuckerkandl mentions the fact that they do occur.

Recently Woodruff reported a case of bone metastasis following carcinoma of the bladder. Westerkamp has also reported a case belonging to this group.

It may be possible that bone metastasis in bladder carcinoma occurs more frequently than we believe at present and that the bone metastases are overlooked and not recognized.

Several years ago Pfahler called attention to the fact that metastatic carcinoma involving bone is much more frequent than is generally recognized and probably in the advanced stages occurs in nearly 20 per cent of the cases. His paper contains many references to this subject from the roentgenological standpoint.

Because of the fact that carcinoma of the *prostate* produces metastasis in the bones and because this occurs much more frequently than is generally believed, and because carcinoma of the bladder rarely, or supposedly rarely, produces bone metastasis, great care has been exercised in excluding from this paper, cases in which the carcinoma may have been primarily in the prostate gland.

In 1854, Sir Henry Thompson reported a case of bone metastasis from a primary growth of the prostate gland. Since then various articles on the subject of bone metastasis in carcinoma of the prostate have appeared. Blumer, in 1909, collected 43 cases in his paper, to which he added 2 later cases, and, recently, Bumpus, in reviewing 362 cases of carcinoma of the prostate, was able to find evidences of bone metastases in 79, or 21 per cent, of his series.

It has been stated repeatedly that tumors of the bladder produce metastases late in the course of the disease. Often, metastasis or extension of the tumor outside the bladder is difficult to demonstrate and because of the assumption that metastasis occurs late in the course of the disease, extensive radical operations are advised and carried out.

With the above-mentioned statement I wish to disagree. That bone metastases can occur relatively early is illustrated in 3 of the cases in this series in which the cystoscopic examination showed tumors that were relatively small and that from the cystoscopic appearance were ideal cases for wide resections. These 3 cases further demonstrate clearly the necessity for careful roentgen-ray studies of all cases of carcinoma of the bladder for the presence or absence of bone metastases before the patient is subjected to an extensive operation, since the uselessness of operating upon such cases is apparent. The same statement is true if a course of radium treatment is decided upon. Needless to state that the value of this knowledge in giving our prognosis is self-evident. This fact becomes all the

[1]Read at the annual meeting of the American Association of Genito-Urinary Surgeons, Richmond, Virginia, May 2–3, 1921.

more important if we take into consideration the wave of enthusiasm sweeping over the country in favor of radium treatment.

This paper is based upon a study of 3 clinical cases that have come under my personal observation during the past 17 months and the autopsy reports of 2 cases kindly placed at my disposal by Dr. Peter Bassoe.

Sex. All these cases occurred in males.

Age. The ages were as follows: forty-four, forty-four, forty-six, sixty-three, and seventy-two.

The 3 clinical cases were the three youngest in the group. All three were under 50 years of age.

SYMPTOMS

Pain was present in each case. An analysis of the pain showed that there were two types of pain. The first type of pain was the pain incident to the carcinoma and as such was not different from the pain in any case of cancer of the bladder. The pain was associated with urination and was severe, sometimes being described as burning in character. In one case the act of urination was free of pain.

The second type of pain was that due to the metastatic involvement of bone, and in these cases, as would be expected, was very severe and excruciating, requiring large doses of morphine to control it. Its severity was in no manner different from the severe pain seen in other forms of bone carcinoma. The pain was localized in the bony structures that showed the metastases and was recorded as follows: back and abdomen; perineum, hip and over pelvis; perineum and upper two-thirds of the thigh and back. In 2 cases it was referred to the testicle.

Hæmaturia, burning, and frequency were present in all the cases. In one case incontinence was mentioned.

CYSTOSCOPY

Cystoscopic data were available in the 3 cases under personal observation. These showed the presence of a single tumor in each instance, located as follows: near the right ureteral orifice; near the left ureteral orifice, and in the apex of the bladder. The tumors varied in size, being described as the size of a plum; as large as an almond; and smaller than a twenty-five-cent piece. Two of these were described as papillary tumors and one as a carcinoma.

As previously mentioned in this paper, the tumors were all small and so situated that they would have been ideal cases for wide resection, although in one case this would have meant transplantation of the ureter.

Particular emphasis is being laid upon the fact that these tumors were small at the time the patients first came under observation, illustrating that although the *primary tumor of the bladder may be small, extensive metastases may be present.* Because of the small size of the tumors and the absence of bladder-wall involvement in 2 of the 3 cases, these patients appeared, at first examination, to be very early cases; the tumors favorable ones for resection, and apparently the chances for recovery excellent. A similar condition may be met with in carcinoma of the prostate in which the primary tumor may be very small and yet have produced extensive bone metastases.

ROENTGEN-RAY FINDINGS

The 3 cases under my personal observation were subjected to careful roentgen-ray examination and in all three evidences of bone metastases were present. The metastases were rather extensive in 2 of the 3 cases and apparently out of proportion to the size of the primary growth in the bladder.

The roentgen-ray findings were those of simple massive bone destruction which were seen at intervals to progress by continuity, multiple foci having been observed at various stages of development in various portions of the lower spine and pelvis. In 2 cases the pubis and ischium were involved. In none of the lesions was there any pronounced sign of new bone development about the lesion, the striking appearance being that of simple irregular bone destruction.

In one case there was evidence of new bone formation as demonstrated in a piece of bone removed at autopsy.

METASTASES

Two types of metastatic carcinoma of the bone are recognized: osteoclastic and osteoplastic, the osteoclastic leading to bone

Fig. 1. Case 1. Roentgenogram showing practically total destruction of the ischium with partial destruction of pubis. Note absence of new bone growth.

Fig. 2. Case 1. Roentgenogram showing further destruction of pubis and ischium which has now involved also the opposite side.

destruction. In the osteoplastic type new bone formation predominates over bone destruction so that the bones become very hard and dense, which phenomenon can easily be recognized in the roentgenograms. This type of bone metastasis is frequently seen in carcinoma of the prostate. According to Kaufman, the osteoclastic type of metastatic carcinoma occurs more commonly than does the osteoplastic. In this series all 5 cases belonged to the osteoclastic type.

Autopsies were performed in 3 of these cases and the metastases were found as follows: in Case 2, in the glands in the perivesical fat, and in the bony pelvis; in Case 4, in the bony pelvis, right eighth rib, left second and ninth ribs; in the mesenteric, retroperitoneal, inguinal, and tracheobronchial glands, and in the liver; in Case 5, in the eighth rib and in the liver.

Autopsies were not performed in 2 cases and the metastases as determined by the X-rays were as follows: in Case 1, in the bony pelvis (Figs. 1 and 2); in Case 3, in the spine.

Metastases to the skin are uncommon in this type of tumor. In Case 1 metastasis to the skin occurred. A hard nodule was seen in the mid-axillary line and this was removed under local anæsthesia. Histological examination showed the presence of carcinoma.

HISTOLOGICAL EXAMINATION

In 2 of the 3 clinical cases pieces of the tumor were removed with the cystoscopic rongeur and as a result of histological examination a diagnosis of papillary carcinoma was made in each case. In the third case the diagnosis was verified by sections obtained at autopsy.

Case 1. A. N., age 46, referred by Dr. D. E. Murphy and Dr. G. Noger. Hæmaturia was first noticed 7 months before admission to hospital. No pain or frequency were present at onset. Patient passed clots of blood at intervals of a week or so ever since.

Three months ago patient began to have pain in the perineum. This gradually became worse and patient could not work because of it. The pain seemed to be located chiefly about rectum. About 16 days before admission to hospital he began to have severe pains anterior to left hip-joint and in left hip-joint, radiating down leg to knee and sometimes below knee. Pain became so severe patient could not sleep.

One month before admission patient began to get up nights to urinate and voided every hour during the day.

Fig. 3. Case 2. Roentgenogram showing bone destruction in left ischium with lesser amount in sacrum near sacro-iliac joint.

Rectal examination showed prostate, negative; seminal vesicles, palpable.

X-ray examination. The urinary organs were negative for stone. The bladder outline was apparently normal in contour. The bony pelvis showed definite change, involving the horizontal ramus of the pubes, the symphysis, the descending ramus of the pubes, and ascending ramus of the ischium. The bony structures seemed to be absent, having a washed-out appearance. No areas of new bone formation could be seen. The symphysis on the left side seemed to be rough and irregular (Figs. 1 and 2).

Cystoscopy. In the apex of bladder was seen a papillary tumor about the size of a large hazelnut, not definitely pedunculated. Piece removed for histological section showed a papillary carcinoma.

Patient noticed a small nodule about the size of an olive in the mid-axillary line of right side of chest, not painful and apparently not connected with bone. The subcutaneous tumor was removed, and histological examination showed carcinoma of same appearance as tumor removed from the bladder.

CASE 2. C. B., age 63, referred by Dr. H. C. Weiskopf. Hæmaturia was the first symptom, about 7 months ago, and was not associated with pain. Some weeks before onset, however, patient had pain in left kidney. There has been much bleeding for 1 week, also occasional clots. Burning in urethra has been present for 3 months, gradually increasing in severity, and present during act.

About 3 months before admission to hospital the pain in the urethra and perineum gradually

Fig. 4. Further bone destruction in Case 2. Probable pathological fracture of ramus of ischium.

became worse until at time of admission patient had to take opiates. Pain extended to end of glans and was present constantly, but worse at night. Pain was present around coccyx and in inner and upper two-thirds of thigh, and on account of its constancy interfered with walking. Pain, not severe in character, was present in left groin, seemingly having its origin in a swelling which appeared to be a hernia. Patient complained of a dull ache in the left testicle, which symptom had been present for 6 weeks and was aggravated by being on his feet.

For several years frequency had been present, and at time of admission patient had to void every half hour during the day and six times at night. Stream had lacked force for about 6 months, and dribbling was present at end of urination.

Loss of weight was 25 pounds in 2 years.

Rectal examination showed prostate not enlarged or hard, but firm, especially in upper pole of left lobe.

X-ray examination. The urinary tract was negative for stone. There was a very definite osseous defect in the ramus of the left ischium, which consisted of bone destruction to a large extent; a slight disturbance of a definite nature was also seen in the sacrum (Figs. 3 and 4).

Cystoscopy. The left ureteral orifice could not be seen. Near the internal urethral orifice was a tumor about the size of a twenty-five-cent piece.

Patient left the hospital but returned in a few days complaining of a large amount of hæmorrhage from the urethra, pain in left thigh, pains in region of bladder on urination, and pain on pressure over left sacro-iliac joint, sacrum, and left side of sacrum.

Cystoscopy, January 6, 1921. The tumor previously noticeable was much larger, extending to the internal urethral orifice.

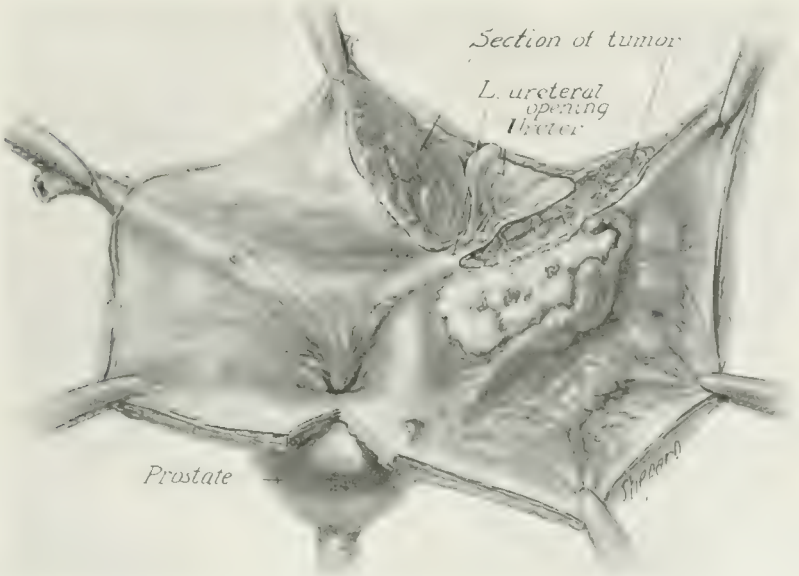

Fig. 5. Case 2. Primary carcinoma of bladder and constriction of ureter with dilatation above. Prostate and neck of bladder normal.

Patient died February 7, 1921. *Autopsy.* Kidneys, ureters, bladder, and prostate were removed intact. The glands in the perivesical fat were large and palpable; prostate, negative (Fig. 5); to the left of left ureteral orifice for about ½ inch outward and 2 inches upward extended a hard tumor mass, crescentic in shape and covered with mucosa. The center of the tumor was necrotic. As the ureter passed through the tumor mass it was very distinctly narrowed, and directly above this, dilatation began.

Case 3. O. S., age 44, referred by Dr. B. N. Parmenter.

Patient complained of pain in the back, burning on urination, frequency, incontinence and hæmaturia. Pain in back was first noticed 3 years before coming under observation, was located just above the pubis and passed into the penis, being noticed more after urination. First attack lasted 3 days; another attack 2 years later, lasted 1 week, and then pain, more severe, began in the back and radiated to the pubis and into the penis. Another attack was experienced, 9 days before admission to hospital, with pain which began above crest of the ilium in the lumbar region and radiated to the pubis, the penis, and down the legs on both sides. Attacks lasted from 15 to 30 minutes and occurred at short intervals. Physical examination was negative.

X-ray examination. Negative for stone in bladder, ureters, kidneys or prostate.

Cystoscopy, January 12, 1920. Tumor as large as a plum was seen in region of right ureteral orifice. A piece removed for histological examination showed papillary carcinoma.

Roentgen-rays at this time showed no changes suggestive of bone metastasis; therefore operative treatment was suggested and refused. In lieu of operative treatment patient was treated with radium and bipolar fulguration. A cystoscopic examination, July 27, 1920, showed the bladder to be free of tumor although the base was still somewhat œdematous. Patient was free of urinary symptoms for 3 months, after which time he began to complain of severe pain in the back. Spinal fluid at this time was negative. Because of the persistence of the severe backache a second roentgen-ray examination was made, November 8, 1920, and Dr. Potter reported to the effect that the plates showed evidences of bone metastasis in the lower part of the body of the fourth lumbar vertebra and on the right side of the first portion of the sacrum. A third examination was made January 5, 1921, and showed evidences of metastasis in the sacrum.

Patient died January 21, 1921. Autopsy was refused.

The following 2 cases were not seen by me but the data was kindly placed at my disposal by Dr. Peter Bassoe who performed the autopsies.

Case 4. H. K., age 44. An internal urethrotomy had been performed 20 years ago. Four months ago patient fell on right hip. Three months later he had pain and tenderness in right half of pelvis. A small, hard tumor appeared at right sacro-iliac joint, not adherent to skin.

After illness, 20 years ago, patient was well until 1 year ago. At that time he began to have painful and frequent urination. Urinary condition grew worse after fall on hip. At present he voids every 10 minutes.

Operation. A tumor the size of an orange was removed from the bladder, and part of right ilium was also removed. Patient died 22 days later.

Autopsy. Carcinoma involved the bladder, the mesenteric, retroperitoneal, inguinal and tracheobronchial glands, the liver, the bony pelvis, the right eighth rib, the left second and ninth ribs. There was a pathological fracture of the left eighth and the right second ribs. There was an ascending cysto-, uretero-, pyelonephritis with dilatation of the right ureter and renal pelvis, also a bilateral serofibrinous pleuritis. An abscess was found behind the right psoas muscle, as well as a septic arthritis of the right sacro-iliac joint; a sloughing operation wound of the back; an œdema and congestion of lungs, and an acute splenitis.

CASE 5. H. M., age 72. Patient complained of pains in back and abdomen, principally on right side, sometimes radiating down right thigh and testicle.

Operation. About one-half of bladder wall was resected. Patient died 6 days after operation.

Autopsy. Metastases were found in the liver and the right eighth rib; a nodular tuberculosis of both lungs; bilateral fibrous pleuritis; an anthracosis of lungs and of tracheobronchial lymph glands; sclerosis of aorta; arteriosclerotic atrophy of kidneys; chronic gastritis; acute cystitis and urethritis; localized fibrous pericarditis; fibrous perisplenitis; decubitis of urethra; accessory spleen; patent foramen ovale.

SUMMARY

1. Bone metastases occur beyond a doubt in cases of carcinoma of the bladder.

2. Their occurrence is uncommon as compared to the frequency of bone metastases in carcinoma of the prostate.

3. Extensive metastases may be present although the primary tumor in the bladder be small.

4. Prior to operation or radium treatment, routine examination of the osseous system, by means of roentgen-rays, to make certain the presence or absence of metastases should be carried out in all cases of carcinoma of the bladder.

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SARCOSPORIDIOSIS INVOLVING THE BONE

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THIS paper is in the nature of a preliminary report, the mass of details involving experimental technique being retained for special publication.

In November, 1916, I showed the members of the Interurban Orthopedic Club, meeting at Kernan's Hospital for the Relief of Crippled and Deformed Children, Baltimore, two cases of multiple bone cysts. One of these was a boy aged 11 with tumors of the right thigh and left humerus. At that time I reported odd sporocysts in the fluid removed the preceding day and noted the granulomatous condition of the cyst walls with a peculiar non-recognized condition in a sequestrum removed with the cyst contents. These findings added to negative Wassermann reaction and cultures and the boy's generally fine condition suggested an unusual pathology. The study of the case, begun November 24, 1916, was interrupted by my call to military duty May, 1917, and was not taken up again until recently. The summary of our investigations follows:

The patient, a perfectly healthy looking boy, aged 11, was admitted to Kernan's Hospital October 16, 1916, complaining of painless swelling of the right thigh and left humerus.

There was nothing of interest in his family history. A brother died at the age of 9 of "muscular paralysis" after 3 years illness. Patient's present illness dates from May, 1916, when he was treated for "inflammatory rheumatism" of both knees. These pained for a week; onset was sudden. An X-ray of his right knee taken before entrance was diagnosed as tuberculosis.

Physical examination of thigh on entrance: The right thigh presented a fusiform swelling involving the lower two-thirds of the thigh excluding the articular surface of the femur. The mass was regular in outline, smooth and protruded backward so far that the leg was flexed on the thigh to 70°, due to pressure on the hamstring tendons. On the outer side of the thigh, 3 inches above the knee, there was an area of softening, red and fluctuating. There were no large engorged veins. Glands in the right groin were enlarged; none noted elsewhere. On the humerus just below the deltoid tubercle was a swelling three-quarters by one-half inch in size.

X-ray of the right femur showed a large fusiform bone "tumor" involving about two-thirds of the shaft. In it were two rather punched-out areas circular in form and an apparent sequestrum.

An X-ray picture in the form of a lantern s ide was interpreted May 30, 1921, as follows: Cystic condition of posterior lower half of femur; eroded condition of the shaft and anterior bend; 2 small sequestra under the raised periosteum on the outer side surrounded by definite oval outlines; bone absent for the greater part of the bulging on the inner side; oval shadows throughout the cyst posteriorly and to the inner side where the bulging is greatest.

Blood count: polymorphonuclears 74 per cent; eosinophiles 4 per cent; increase in large mononuclears. Wassermann test negative.

Fig. 1. Sarcocyst. Periosteum next to cyst.

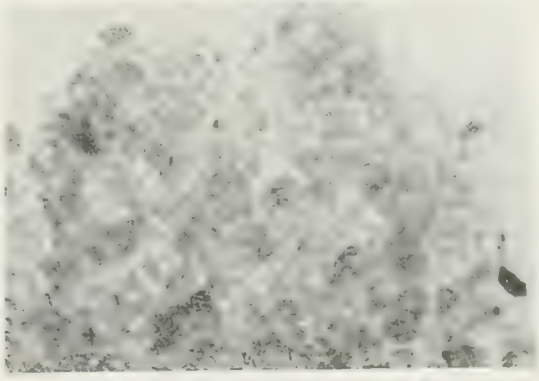

Fig. 2. Sarcoblasts in granulations of cyst contents.

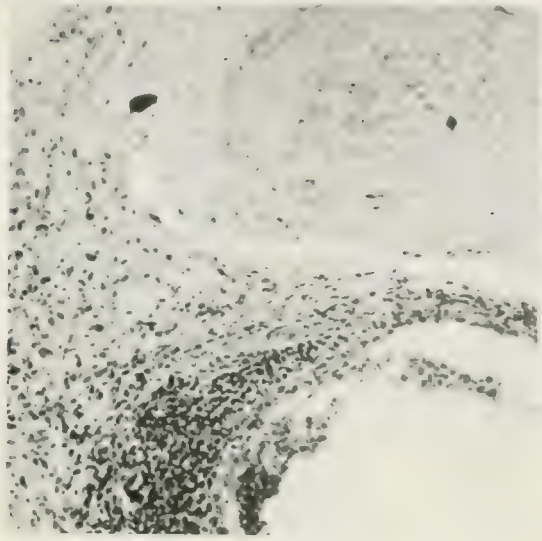

Fig. 3. Periosteum. Cyst wall in femur.

Operation, November 24, 1910. An incision 2 inches long was made over the most prominent part of the tumor, external portion of thigh. Skin dissected back one-half inch. Two parallel incisions, one-half inch apart, now made through muscle and periosteum. These incisions were deepened by motor saw into the bone which was soon perforated into a cyst cavity. On attempting to raise this piece of bone the chisel penetrated the cavity to the depth of about 3 inches. A great quanitity of gelatinous, straw-colored fluid, a fibrinous material, blood clot, and a sequestrum about the size of a finger were discharged. The free end of the sequestrum had undergone "cystic degeneration." Hæmorrhage was free and two handkerchiefs of gauze packing were packed in to control it. The cavity of the cyst rested upon the popliteal vessels, being separated from them by a wall of exudate.

Recovery was good. Temperature remained about normal from the time boy entered until he was discharged 10 months later.

On January 5, 1917, the "tumor" on the left humerus was operated on and his tonsils were excised. Dr. Edwards, who was then house surgeon, operated.

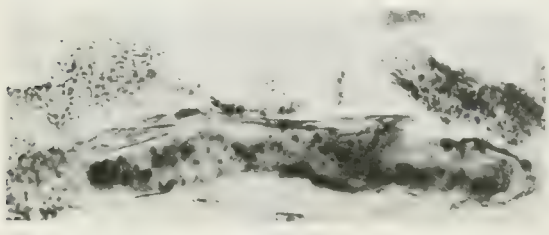

Fig. 4. Sarcosporidia in granulations of cyst.

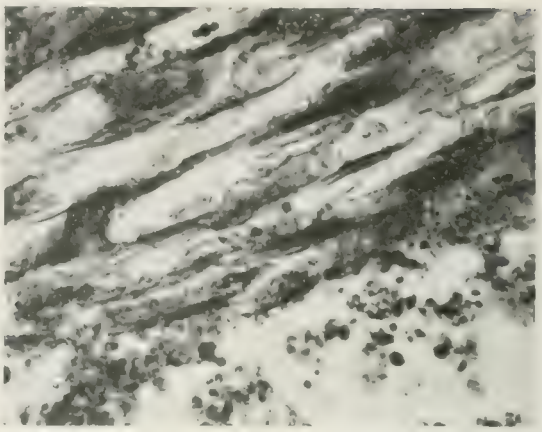

Fig. 5. Miescher's tubes at suprarenal of guinea pig.

Operation note: An incision was made over the summit of the tumor which was just below the insertion of the deltoid. The muscles were dissected away and an attempt was made to excise *in toto*, but we broke into the cavity and found a slight amount of pus and a sequestrum about the size of a darning needle and 1.5 inches long. The cavity was curetted and the wound closed with catgut sutures. Tonsils and adenoids were removed in the usual manner; considerable caseous material was found in the tonsils. Recovery was uninterrupted.

Pathological examination. A piece of the wall of the cyst about 1.5 centimeters thick was found to be of firm consistency and of gray color with softer whitish areas and few solid islets of new bone and cartilage 1 by .5 centimeters in size. On its innermost surface is a piece of eroded bone like a sequestrum attached to the new semi-solid gray tissue; this was the perforated bone cortex next to thickened periosteum.

The cyst contents are a yellowish brown, gelatinous fluid with blood clots and a grayish soft tissue (granulation tissue) included. Immediate examination of the fluid demonstrates, in the blood, fibrin and congeries of capillaries, a great number of large, round, and oval, yellowish brown cystic bodies with double contour containing hyaline spores. Each body contains from 8 to 20 such spores. There are very few polymorphonuclear leucocytes. The bone, granulations, periosteum, and cyst contents were examined fresh, in salt, glycerine and glacial acetic acid. Specimens were fixed in Zenker's fluid, alcohol, formalin, and acetone. Various staining reagents were used: hæmotoxylin and eosin, alum carmine, giemsa, gram, gentian violet, methyl blue, polychrome methylene blue, and phosphotungstic hæmatoxylin. The odd bodies were studied in ether, chloroform, caustic potash, salt solution, glycerine and glacial acetic acid.

Both free-hand and hardened specimens were examined, mounting in celloidin and paraffin.

White rats and guinea pigs were used for feeding and inoculation tests to determine the character of the bodies which I thought were sporocysts of some kind.

Granulations on surface of periosteum. At one edge is a piece of new-formed bone callus resembling cartilage. This is surrounded by round-celled infiltration, new vessels, some muscle fibers with increased nuclei and very few polymorphonuclear leucocytes. Some muscle fibers are degenerated and appear as empty or half filled fibers. In this tissue are numerous round and oval bodies 15 to 40μ in size. These contain transparent oval and round bodies 12 to 15μ in size, each containing one or two hæmatoxylin stained dots (nuclei) 1 to 2μ in size. Some of these bodies are sickle-shaped and nucleated.

Granulations from the cyst contents (see Fig. 2) which had been in caustic potash and then stained in methyl blue and eosin show separate transparent bodies 20μ in size with a minute orifice communicating by a canal with a two-lobed central body (see Fig. 1). These bodies resemble the smaller sporoblasts pictured by Park and Williams.

Some of the 20μ sized bodies are granular and unstained. Granulations from the sinus at the site of operation on the humerus cyst contain sickle-shaped, hyaline bodies with two nuclei 2μ in size.

Individual sporoblasts were isolated from the granulations, treated with ether, chloroform, caustic potash and glacial acetic acid. They are usually brown at first but lose this color (probably pigmented by blood). Pressure on the coverslip changes the shape and size to five times the normal, but does not crush the cyst. They contained round or oval bodies which became clearer. Eventually one larger body is crushed in glacial acetic acid, the walls are jagged, the contents scattered. Similar bodies are seen in granulations on the end of a sequestrum.

The sequestrum is eroded bone with Howship's lacunæ lined by large cells. There are irregularly outlined and smooth haversian canals containing fine granular bodies stained with hæmatoxylin; these are 30 to 100μ long by 20μ wide and within walls 2 to 3μ thick. Faintly outlined in these are hyaline bodies 15μ in size, some containing 2μ sized nuclei; some of them are open-mouthed with a central canal widened or double in the center of the body. There are a few polymorphonuclear cells among them; no vessels, and the walls of the cysts are hyaline and 2 to 3μ thick. Many of the smaller haversian canals contain bodies (sarcoblasts) corresponding to their size and in these are the small sporozoites with one or two nuclei. Some of these are granular with refractile bodies. In some of the haversian canals are seen several sporocysts like those described in the original cyst contents, granulations and softer part of the periosteal tissue. No

Fig. 6. *a* Sarcocysts, *b* Miescher's sac, *c*, sporozoites, *d*, spores.

granulation tissue is seen in the eroded bone of the sequestra.

In the dense connective tissue of the periosteum are great numbers of epithelioid and round cells gathered in groups, some of them resembling germinal centers of lymph glands with very large centers and several layers of marginal small round cells. Here and there in the connective tissue is a giant cell with four or five centrally placed nuclei, a few plasma cells and few newly formed vessels. The vessels are greatly thickened by periarteritis and endarteritis, some of them being almost obliterated. (The early note mentions a few areas "resembling fat" at the outer edge of the periosteum, later investigation demonstrates these to be sarcocysts). There is only one area containing polymorphonuclear leucocytes.

In one of the sections of periosteum is seen a chambered arrangement such as is pictured in Miescher's sacs. In some of the chambers which are 20 to 40μ wide, faintly outlined hyaline areas are subdivided into smaller 14μ divisions. Individual nucleated and non-nucleated sporozoites are seen in the surrounding connective tissue and on the surface of the periosteum next the cyst contents. There are few remnants of muscle along side. Staining with Giemsa's method is negative. These same bodies are found in degenerated vessels and spaces left in the sequestra. It is difficult to recognize them unless they occur *en masse*. The sporozoites cannot be distinguished when mixed with cells but are easily seen in the oval sporoblasts. They often appear in the bone canals in their various stages of growth (Fig. 4). Most of them show no nuclei but in some sections they contain one and two 2μ sized nuclei. The granular sporozoites were only seen in degenerate vessels and bone canals; their nuclei staining blue, the granules appearing as refractile dots.

Granulations and muscle are seen side by side in the section of the cyst of the humerus. Young and adult (cellular and fibrous) connective tissue are located in and about new bone formation near the sequestrum. New bone formation, with osteoblasts lining it, is alongside areas of bone undergoing lacunar absorption. Koelliker's osteoclasts fill the Howship's lacunæ. There is a small area of new bone formation with transition through cartilaginous

stage (bone callus) in the center of granulation tissue with many plasma cells, some in little groups. There are a few isolated areas of polymorphonuclear leucocytes. Vessels show endarteritis and periarteritis. Sporozoites are seen in groups and within the sporocysts in the sequestrum, in the granulations, and among the degenerated muscle. They are commonly seen faintly outlined in masses of fine hæmatoxylin stained granules.

EXPERIMENTAL

White rats were fed on material from the cyst of the humerus. The animals were killed with chloroform and autopsied in 31 days. There was a cyst 1 centimeter in diameter in the stomach wall under the peritoneum at the entrance of the œsophagus. One-fourth of the stomach was fully of milky, semisolid material. Microscopically there were many elongated oval, 30 by 6μ sized objects with a linear central cleft and crescentic objects 20 by 5μ in size with central depression like a linear orifice. There were also many granular spores resembling yeast cells in a meshwork resembling fine branching fibrin. The cyst contained many oval, hyaline bodies, 30 by 15μ in size, with a double contour. Inside of these is what looks like a rounded divided body. There are also crescentic round and oval hyaline bodies 10 by 15μ in size with three or four oval spores at the mouth. These can be expressed on pressure. The small intestines shows on its peritoneal surface a few 3 millimeter sized bulgings which contain spore-like bodies, the size of yeast torula. In the contents of the intestine are many brown oval bodies like those described in the original cysts of femur and humerus and clumps of spores like yeast. In the rectum was milky fluid, containing bodies like those described in the stomach, and yeast-like spores as in the intestine.

The guinea pig died 8 days after injecting material from the humerus cyst into its peritoneal cavity.

There was pus about the suprarenals, liver, and in the pericardium. Intestinal contents showed a few crescentic bodies 20 by 5μ with depressed central orifice as seen in the stomach of the white rat. The suprarenal was much congested and at the point where pus was present on its surface the cortical cells were absent. There was a mass of tissue surrounded by pus, arranged to form chambers irregular in outline like the chambered forms of sarcosporidia in muscle (Fig. 5). In them are many sarcocysts and sporozoites in the form of Miescher's sacs full of granules, many are empty. Some forms are 40μ by 10μ in size and contain sporozoites. There are a few free sickle and oval shaped 14 by 4μ sized sporozoites. The walls of the chambers are 2 to 4μ thick and irregularly placed.

In the granulation tissue and pus on the surface of the liver are a few double contoured hyaline cysts 25 by 15μ in size containing spores like torula. There are many of these small forms in clumps.

There is round-celled infiltration and polymorphonuclear leucocytes in small groups in the heart muscle. Pus covers the pericardium. There are a few double contoured cysts 15μ in size with granular contents and faintly outlined spores in the interstitial tissue. In one area is seen a mass of hyaline oval, 15 by 7μ sized, bodies in a fibrin-like meshwork.

We have described the parasite in all of its forms from the round, oval, sickle-shaped, nucleated and non-nucleated, granular or hyaline sporozoites to the elongated or round and oval sporocysts containing sporozoites. The chambered form first described by Miescher was also seen.

Any unusual appearance in our case may be explained by Darling's statement: "Sarcosporidia of abortive types cannot be identified in unusual hosts until their derivation and host relationships are known. The guinea pig and human sarcosporidia both represent abortive or aberrant types."

Braun says the spores vary in form in different species. It has only been seen four times in man in whom it involved the muscle; in one case the liver was also affected. In no case was bone involved.

Theobald Smith in writing of sarcosporidiosis says there is no pathological change in the muscle due to the parasite. Park and Williams write that cysts may burst and their contents spread into surrounding tissue pro-

ducing abscesses and tumors. Laveran refers to the irritating toxic quality of the parasite. Direct inoculation has not been successful according to Smith and others. The guinea pig I injected with material from the humerus showed the sarcosporidia.

Echinococcus and cysticercus cysts have been recorded in bone (Virchow and Kanzow, Hahn, Corlette and Ritter) but I do not find reference to sporocysts involving bone. I judge that in our case the involvement was primarily in muscle, the bone being secondarily invaded. It would appear from the operator's note that the invasion was from the popliteal region as there was no bone remaining between the popliteal vessels and the cyst. It would appear that the bone destruction was similar to what occurred in Virchow and Kanzow's case, being due to direct pressure and action of the parasite's growth. There is no evidence of purulent involvement of bone or soft parts.

Corlette records cysts in femur and pelvic bones in hydatid disease.

I wish to thank Professor Spencer for valuable aid given me in this work.

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THE UMBILICAL CORD

Normal Length; Length in Cord Complications; Etiology and Frequency of Coiling

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THIS study was undertaken to determine the average length of the umbilical cord, the shortest possible length in which birth takes place without traction of the cord, the length of cord necessary when complicated by a loop or a coil in a vertex or breech presentation without traction on the cord; the etiology of coiling of the cord and the frequency of coiling.

The umbilical cord is a long, slender string, soft and flexible, which connects the fœtus with the placenta (Littre and Robin, 1). When its continuity is interrupted, the fœtus dies, demonstrating the fact that it is an organ vital to intra-uterine life. Most embryologists agree that by the end of the first month of pregnancy the cord is completely formed. From this time until term, it develops *pari passu* with the fœtus. Some authors (Alliver, 2; Jacquemier, 3), however, state that between the first and fifth months the umbilical cord is longer than the fœtus, even half again as long. At birth, the umbilical cord has a variable length. By Credé (4) the average length of the cord is said to be 52.5 centimeters, by Tarnier (5) to be from 45 to 60 centimeters, by Williams (6) to be 55 centimeters, by De Lee (7) to be 50 centimeters, by Hart (8) to be from 50 to 70 centimeters, and by Tweedy (9), 45 centimeters. Leray (10) reported from Tarnier's clinic in 1893, 10,457 labors in which the average length of the cord was 54.4 centimeters, of which the shortest cord was 10 centimeters and the longest 172 centimeters. More recently Cragin (11) published his statistics in 10,000 labors in which the average length of the cord was 59.1 centimeters, in which the shortest was 10 centimeters and the longest 140 centimeters. Leray (10) states that the placenta has been reported to be actually attached to the abdomen of the fœtus, no vestige of the cord being present. Cazeau (Tarnier) reported a cord 3 meters in length. These extremes in the length of the cord may be classed as malformations. For the normal length of the umbilical cord, then, we may properly accept the average length of 55 centimeters (22 in.).

There are two classes of short cords: a cord which reaches from the placenta to the vulva not interfering with the birth of the child, and, according to Tarnier (5), not being less than 35 centimeters in length, is a relatively short cord; a cord which does not reach from its insertion in the placenta to the vulva and which does interfere with the progress of birth, is an absolutely short cord. A cord of normal length, or even longer, which has been shortened by coils or loops about parts of the fœtal body and interfering with delivery, is accidentally short and is known as a shortened cord. A loop in the cord is a sling over a part of the fœtus, while a coil must completely encircle a part of the fœtus.

In shortened cord cases the size of the fœtus is of importance because the larger the fœtus the more of the umbilical cord is taken up by a coil or loop. I measured twenty-five fœtus, each weighing a little over 7 pounds, and the following average was obtained: From the umbilicus to the sternal notch was 15.00 centimeters, the circumference of the neck was 17 centimeters, the circumference of the chest was 32.00 centimeters, the thigh was 12.50 centimeters, arm 9.00 centimeters, ankle 8.50 centimeters, and wrist 7.50 centimeters. A loop over the neck from a point just external to the sternal head of one clavicle to a point just external to the sternal head of the other clavicle measured 14.50 centimeters. A coil about the neck included the loop 14.50 centimeters plus 17 centimeters, the circumference of the neck, and measured 31.50 centimeters.

In order to understand the effect of short or shortened cords on otherwise normal labor,

one must follow the progress of labor step by step. At term, the fundus of the uterus is 30 centimeters from the vulva; after the birth of the head the fundus is 28 centimeters from it; immediately after the birth of the fœtus with the placenta *in situ* the fundus is 25 centimeters distant (these measurements may seem to disprove the fact that during birth the fundus follows *pari passu* the descent of the fœtus; the fundus does descend, however, *pari passu*, until stopped by the bulk of the placenta) and immediately after the expulsion of the placenta the fundus is 18 centimeters from the vulva (after the expulsion of the placenta, under the influence of pituitrin and with Credé, the fundus can be made to shrink down below the top of the pubes). At the onset of labor, the fundus is still 30 centimeters from the vulva and the fœtal vertex is usually from 5 to 10 centimeters above it, depending upon whether the fœtal head is in the pelvis or at the superior strait. After labor, the distance from the vertex to the buttocks of the fœtus measures 32 centimeters, showing that the position maintained by the fœtus *in utero*, called the fœtal ovoid, is less than the length of the fœtal trunk. In a vertex presentation as labor progresses the relation between the umbilicus and the placental site may be undisturbed, because of the descent of the placental insertion of the cord *pari passu* with the umbilicus of the fœtus, until the umbilicus of the child passes the cord's insertion in the placenta. The cord is usually inserted eccentrically in the placenta and rarely nearer the placental border than 5 centimeters. So that even in a low placental site the cord's insertion would still be 5 centimeters above the lower uterine segment or superior strait, excluding possibly rare forms when the placenta is prævia. This 5 centimeters, added to the length of the cord, allows the umbilicus to progress to the superior strait, the beginning of the birth canal. The posterior border of the birth canal is 29 centimeters in length (from the sacral promontory to the tip of coccyx is 14 centimeters and from the tip of the coccyx to the fourchette is 15 centimeters, because the distance on the posterior border of the birth canal is now increased to a maximum distance of 15 centimeters due to the distention of the perineum by the descending head). At this time, in a vertex presentation, when the umbilicus is at the superior strait, the vertex is 26 centimeters (umbilicus to neck 15 centimeters, neck to vertex 11 centimeters) down the birth canal and must descend 3 centimeters farther before leaving the birth canal. This 3 centimeters must be added to the already calculated 5 centimeters of the umbilical cord, making now 8 centimeters. As the head is born by the retraction of the perineum over it, the muscular end of the birth canal is shortened thereby to about 6 centimeters (distance the perineum now is from the coccyx). The 6 centimeters and the distance (11 centimeters) from the coccyx up the birth canal to the umbilicus (coccyx to superior strait 14 centimeters less the 3 centimeters due to the descent of the umbilicus) makes 17 centimeters to be added to the already calculated 8 centimeters, or 25 centimeters. The fundus immediately after the birth of the head assumes a globular shape and measures transversely 15 centimeters. This includes the thickness of the uterine walls, the thickness of the placenta, the fœtal buttocks, about 4 centimeters of which still remain above the superior strait, and the remaining liquor amnii which is about (Ahlfeld, 600 cubic centimeters, 12) 500 cubic centimeters, 100 cubic centimeters usually escaping when the membranes rupture. The length of cord required because of the presence of the liquor amnii has already been accounted for (5 centimeters' distance from the insertion of the cord to the superior strait or the beginning of the birth canal). In a vertex presentation, in order that the umbilicus be born the cord then must be 25 centimeters, and if the cord be not cut, in order that the buttocks be born, 7 centimeters (umbilicus to anus) must be added making 32 centimeters. Nothing needs to be added to the length of the coil to allow the birth of the lower extremities, for as soon as the buttocks are born the thighs and legs are pushed out in more or less flexion with the liquor amnii. Therefore, in order that the fœtus be born without traction on the cord, the umbilical cord must be 32 centi-

meters in length. Any cord under 32 centimeters is an *absolutely short cord*, and a cord which is over 32 centimeters in length and under the average length (55 centimeters) is a *relatively short cord*. In the main this estimate agrees with that of 35 centimeters which Tarnier made.

Having determined the length of cord necessary in a vertex presentation, the next step will be to determine the length of cord necessary in a breech presentation. With the breech in the pelvis and the umbilicus at the superior strait, 5 centimeters should be added to allow for the insertion of the cord in the placenta above the superior strait. The birth canal, in a breech presentation, is only 24 centimeters long (the buttocks only push away the perineum 10 centimeters from the coccyx and from tip of coccyx to the sacral promontory is 14 centimeters). The 24 centimeters are added to the 5 centimeters, making 29 centimeters, the length of cord necessary for the birth of the umbilicus, as the retraction of the perineum causes its birth. To allow the birth of the head, 26 centimeters (umbilicus to neck 15 centimeters, neck to vertex 11 centimeters) must be added to the length of the cord, making 55 centimeters, the necessary length to deliver the fœtus without traction on the cord in a breech presentation.

The next step to consider is the length of the cord when complicated by loops or coils. The loops or coils are usually about the neck of the fœtus, a coil taking up more of the cord's length than a loop. In vertex presentations, before the onset of labor, a loop of the cord about the neck necessitates that the cord be 29.50 centimeters in length (15 centimeters from the umbilicus to the neck plus 14.50 centimeters, the loop over the neck). When labor begins, the head in the pelvis and the neck opposite the superior strait, the 5 centimeters which allows for the insertion of the cord in the placenta is added to the 29 centimeters (the length of the posterior border of the birth canal), making 63.50 centimeters (29 centimeters, birth canal, plus 5 centimeters, cord insertion, plus 29.50 centimeters, loop over neck), the length of cord necessary without traction for the birth of the neck in a vertex presentation with a loop. If the cord be not severed, the birth of the fœtus will require in addition 13 centimeters (neck to umbilicus 15 centimeters, umbilicus to anus 7 centimeters less the 9 centimeters due to the retraction of the perineum after the birth of the head), making 76.50 centimeters (13 centimeters plus 63.50 centimeters), the length of cord necessary without traction for the fœtus to be born in a vertex presentation with a loop of the cord over the neck. With a coil about the neck of the fœtus, the cord, in order that no traction be exerted on it, requires the length for the loop plus the circumference of the neck (63.50 centimeters plus 17 centimeters), or 80.50 centimeters, to allow the birth of the neck with a coil. For the birth of the fœtus with a coil about the neck 93.50 is necessary (76.50 centimeters for the birth of a fœtus with a loop about the neck plus 17 centimeters for the circumference of the neck). In a vertex presentation with a coil over the neck with no traction 93.50 centimeters is the shortest possible length of cord.

In a breech presentation with a loop about the neck during delivery the cord becomes a spiral and encroaches little upon the length. In a breech presentation with a coil about the neck, a cord length of 75.50 centimeters (15 centimeters umbilicus to neck, 14.50 the loop over neck, 17 centimeters, circumference of neck, plus 24 centimeters, length of birth canal, and 5 centimeters for insertion of cord) is required for birth of umbilicus, and 101.50 centimeters (75.50 centimeters plus 15 centimeters, umbilicus to neck, and 11 centimeters, neck to vertex) is required for the complete birth of child. A cord then exerting no traction must be 101.50 centimeters in length if the fœtus is to be born in a breech presentation. There are several conditions that frequently enter in which act as factors of safety for the fœtus and the mother: it is known that for every 10 centimeters of length, the cord will stretch 1 centimeter (Duncan, 19); traction on the fœtal insertion of the cord will extend the skin of the umbilicus from 1 to 2 centimeters; traction on the placental insertion of the cord will give even more length; in coiled or looped cords length is added to

the cord by the coil or loop pressing deeply into the tissues of the fœtus, the fundus will indent at times (an acute inversion of the uterus may occur); the traction may be strong enough to detach the placenta and allow the birth of the child, and, indeed, tension on the cord may be so great that it may rupture and the birth follow.

The following case illustrates a serious cord complication and shows the conditions which in this case acted as factors of safety:

Mrs. L. was in her sixth labor, the perineum was well relaxed, the second stage was prolonged, pain just above the pubes located the placenta. Because of the failing fœtal heart the child was delivered immediately by Kristeller procedure. The cord was 82 centimeters long, was coiled three times completely about the neck and was pulseless. The child weighed 7½ pounds and was not asphyxiated. There was great traction of the cord and the coils were deeply imbedded in the tissues of the neck. The rapid delivery prevented the inevitable asphyxia and thereby saved the child's life.

The factors of safety were the relaxed perineum, the low location of the placenta, the stretching of the cord, the imbedding of the cord in the soft parts of the neck and the rapid delivery. The amount of traction in this case is readily seen when it is remembered that the length of cord necessary in a vertex presentation with a coil about the neck is 93.50 centimeters.

There are several factors which have been attributed to the etiology of coiling of the cord. A better understanding of the physiology of pregnancy and labor has done away with the theories that the activity of the mother causes coiling of the cord, or that the cord is coiled at the bottom of the lower uterine segment and as labor progresses the fœtal head passes through the coils which remain on the neck, or that uterine contractions cause the coiling of the cord about the fœtus. The comparing of the fœtus to the bobbin of the weaver's loom, passing back and forth through the coils of the cord, is not a tenable theory else knots of the cord would be frequent but the reverse fortunately is true.

Simpson (13) in 1858 brought forward an interesting theory of the production of torsion and coiling. He suggested that the difference between the volume and force of the blood stream in the short straight right fœtal iliac artery and that of the longer, narrower left iliac artery continuing as the umbilical arteries, causes the right umbilical artery to coil about the vein, pushing the left artery in front of it, thus producing torsion of the cord, which, as it increases, like the twisting of a rope, results in coiling of the cord over a portion of the body of the fœtus. He quotes J. Y. Simpson, who states that the convolutions of the cord occur mostly in one direction, namely, passing from the umbilicus over the right shoulder, around the neck, and also, William Hunter, who found in 32 cases that 28 of them coiled from left to right. That there is a preference for one side more than the other is true. More recently, Cragin (11), in 10,000 cases of twisting of the cord found that it occurred in 59 per cent to the right, 23 per cent to the left, 15 per cent right and left and 2 per cent no twisting.

It is now generally accepted that excessive liquor amnii, a long cord, a small sized fœtus and the activity of the fœtus are factors which make for coiling of the cord. By careful palpation of the abdomen during pregnancy much concerning the activity of the fœtus can be learned. The fœtus can be felt to move freely before the seventh month, after that the fœtal head and body are limited in their movements but the extremities remain active. It is not rare to find by palpation the hands of the fœtus as high as the region of the ears; now the supposition may be advanced that the cord is pushed above the ears by the hands; from here the cord, its vessels distended with blood, by its own pulsations assumes a worm-like movement which finally works itself over the head. Whatever may be the final determination concerning the etiology of coiling of the cord, the movements of the fœtus will undoubtedly play a prominent part in it. Once the cord is about the neck it rarely slips off, thus accounting for the frequency of coiling. It has been stated that coiling of the cord occurs as frequently as one in four or one in five births.

Leray (10) reports that in 10,457 cases 702 coilings occurred, 1 in 15 births; in 430 of these cases 1 coil about the neck, 1 in 25 births.

Pause (14) reports that in 1,149 cases 291 coilings occurred, 1 in 3.9 births; in 192 of these cases 1 coil about the neck, 1 in 5.9 births.

Zacharias (15) reports that in 4,000 cases 863 coilings occurred, 1 in 4.63 births.

Bruttan (16) reports that in 500 cases 143 coilings occurred, 1 in 3.49 births; in 134 of these cases 1 coil about the neck, 1 in 3.7 births.

Veit[1] (17) reports that in 9,306 cases 2,054 coilings occurred, 1 in 4.5 births.

Winckel (18) reports that in 300 cases coilings occurred, 1 in 4.35 births.

Cragin (11) reports that in 10000 cases coilings occurred, 1 in 3.7 births, or 26.51 per cent; 1 coil about the neck, 22.63 per cent, 1 in 4.4 births.

The average from these 35,712 cases gives a coil of the cord once in every 5.5 births. Once in every 9.2 births there is one coil about the neck of the fœtus. The statistics recorded by Leray (10) show, a low average in the number of coilings, while Cragin (11) more recently in the same number of cases as Leray records a much higher average of coilings.

CONCLUSIONS

1. For the normal length of the umbilical cord we may properly accept the average length of 55 centimeters (22 inches).

2. Any cord under 32 centimeters is an *absolutely short cord* and any cord over 32 centimeters and under the average length is a *relatively short cord*.

3. In a vertex presentation, the placental insertion of the cord must not be farther than 5 centimeters above the superior strait in order that the fœtus be born without traction on the umbilical cord, and the cord must be 32 centimeters in length.

4. In a breech presentation, in order that the fœtus be born without traction on the umbilical cord, the cord must be 55 centimeters in length.

5. In a vertex presentation with a loop of the cord about the neck, in order that the fœtus be born without traction of the umbilical cord, the cord must be 76.50 centimeters in length.

[1] Veit's report was made from cases collected from the Heidelberg, Marburg, Goettingen, Trier, and Stettin Clinics.

6. In a vertex presentation with a coil of the cord about the neck, in order that the fœtus be born without traction on the umbilical cord, the cord must be 93.50 centimeters in length.

7. In a breech presentation with a loop of the cord about the neck, the loop becomes a spiral and very little needs to be added to the length of the cord.

8. In a breech presentation with a coil of the cord about the neck, in order that the fœtus be born without traction on the umbilical cord, the cord must be 101.50 centimeters in length.

9. The etiology of the coiling of the cord is not yet known but it is generally accepted that excessive liquor amnii, a long cord, a small sized fœtus and the activity of the fœtus are factors which make for coiling of the cord.

10. There is a coiled cord in every 5.5 births.

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RUPTURE OF THE UTERUS DURING FIRST STAGE OF LABOR

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E. J., age 32, para-II, sent for the extern maternity attendant on account of the commencement of labor pains. Soon after the arrival of the attendant she was seized by a sudden severe pain and became collapsed, her pulse about 170 only just to be felt. She was admitted to the Bristol Royal Infirmary within half an hour. Her pulse was found to be just perceptible at 170; she was blanched and only semi-conscious. She rallied slightly after transfusion.

The abdomen was distended by a large cystic, non-contractile tumor, resembling the pregnant uterus, within which the fœtal parts would be palpated. The fœtal heart, previously recorded as being active, was not heard. On vaginal examination the os was found patulous, but not dilated and a hard, rounded body was felt within it. The bladder was emptied by catheter of a small amount of urine which contained albumin and diacetic acid. A provisional diagnosis of concealed accidental hæmorrhage was made and the abdomen opened as soon as possible. On incising the peritoneum a quantity of free blood escaped and the fœtus was found lying in the liquor amnii and enveloped in unruptured membranes. The lower pole of the ovisac, which formed a narrow stalk, was found to pass through a stellate laceration in the fundus uteri, which latter was firmly contracted; abdominal cavity was mopped dry and uterus amputated by classical Porro method. Patient died just as operation was completed.

Curetting on account of hæmorrhage had been necessary after her previous confinement, but recovery from this operative measure had been uneventful.

Careful examination of the laceration failed to produce either to the naked eye or to the microscope any evidence of cicatricial tissue or of weakening of the uterine wall. There was no history of any cause either direct or indirect which could have produced a uterine contraction of sufficient severity to account for the injury found. The placental site was apparently close to, if not entirely covering, the laceration. The actual cause seems inexplicable. It is suggested that it is possible a pregnancy toxæmia, with conditions such as those found in concealed hæmorrhage, was responsible. Against this theory is the fact that the patient was apparently in sound health a few days previously when she was officiating as "wait upon" in the extern maternity department, when she informed the attendant that the services of the department might be called for in her own case at any moment.

Specimen removed from author's case.

DEPARTMENT OF TECHNIQUE

THE TECHNIQUE OF OPERATIONS ON THE THYROID GLAND

By G. W. CRILE, M.D., F.A.C.S., and W. E. LOWER, M.D., F.A.C.S., Cleveland, Ohio
From the Cleveland Clinic

IT is not our purpose in the following paper to discuss the plan of management of goiter patients, which in the case of patients with exophthalmic goiter in particular is essential to the success of surgical measures, but we shall confine ourselves to a description of the surgical technique which has been evolved through our experience in 3512 operations on the thyroid gland.

I. THE TYPICAL LIGATION

All ligations are performed under analgesia and local anæsthesia without removing the patient from his bed. The superior thyroid artery is ligated in preference to the inferior artery for the reason that the latter lies deeper and its ligation apparently is less effective, probably because the nerve supply to the thyroid runs along the wall of the superior artery. The field including

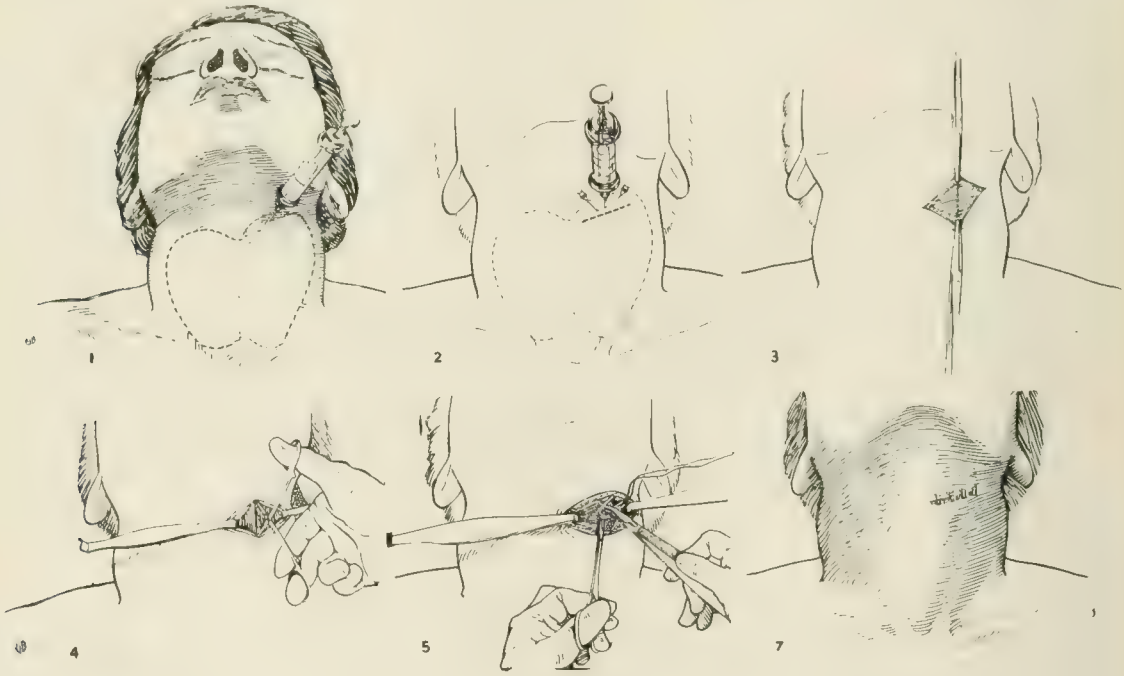

Fig. 1. Ligation of superior thyroid artery. Infiltration of skin.

Fig. 2. Ligation of superior thyroid artery. Deep infiltration for complete protection of field of operation.

Fig. 3. Ligation of superior thyroid artery. Line of incision through fascia.

Fig. 4. Ligation of superior thyroid artery. Separation of fibers of preglandular muscles with narrow-bladed hæmostats.

Fig. 5. Ligation of superior thyroid artery. Passage of suture under artery which is elevated with forceps.

Fig. 7. Ligation of superior thyroid artery. Closure of skin incision with clips.

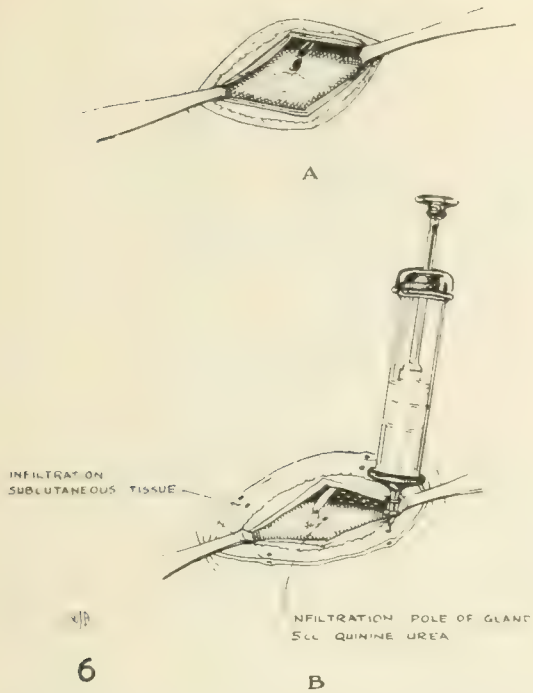

Fig. 6. Ligation of superior thyroid artery. *a*, Sutures of artery and of superior pole. *b*, Infiltration of pole and of subcutaneous tissues with quinine and urea hydrochloride.

the skin, subcutaneous tissue muscles, etc., is completely flooded with 1:200 novocaine (Figs. 1 and 2). Immediately after the novocaine is injected, firm pressure is made over the injected area as this diffuses the anæsthetic and increases its efficiency. The skin is divided parallel to the skin folds, after which the fascia is divided, exposing the preglandular muscles (Fig. 3). The muscles are not severed but the fibers are separated with narrow bladed hæmostatic forceps (Fig. 4) and the divided muscles are held apart to expose the upper pole of the gland by means of special retractors having different sized blades. This retraction gives an almost uniform exposure of the artery which is then picked up and held by a forceps, while a full curved needle armed with silk is carried around it (Fig. 5). A second ligature is passed around all or most of the superior pole to make sure that the artery and not only a branch is included (Fig. 6, *a*).

The tissue involved in the ligature is flooded by injection with 1:600 quinine and urea hydrochloride, as are the subcutaneous margins which are to be grasped in the barbs of the clips, the injection being made from below outward so that

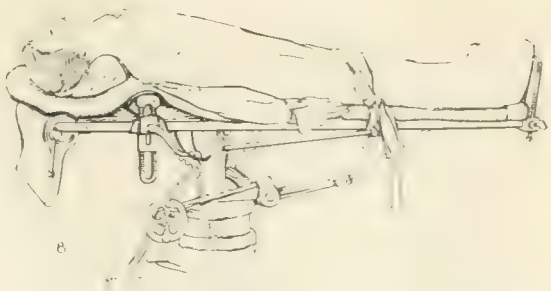

Fig. 8. Typical thyroidectomy. Position of patient on operating table.

the skin border becomes white and œdematous (Fig. 6, *b*). No deep sutures are used. The skin incision is closed with clips (Fig. 7), which are removed on the third day for, if left longer, they may cause slight punctuated scars.

Usually the artery of but one side is tied at one séance, for, if it is a grave risk, the double ligature would increase the hazard too much; and even in apparently safe cases the single ligation may disclose a hazardous situation. Moreover, if there is doubt as to whether the patient might safely endure a thyroidectomy, a single ligation will give the cue; and if the indication is favorable, the thyroidectomy may follow the tell-tale ligation in 3 days. Our rule is: if there is any doubt as to the advisability of the thyroidectomy, make a single ligation. There will be at most only 3 days' loss of time; occasionally the single ligation may mean the saving of a life.

II. THE TYPICAL RESECTION OF THE THYROID GLAND

Posture. The patient is placed on the table in an inclined position, feet downward, and the base of the neck is sufficiently elevated by a small pillow to produce an advantageous elevation of the chin (Fig. 8).

Position of the scar—the platysma. A collar incision, at about the level of the middle and lower thirds of the neck, paralleling the natural folds of the skin is the favored position for the scar. If the goiter is large, especially if the patient has a short, fat neck, the incision must be made correspondingly high above the clavicle, as otherwise the scar will fall down upon the sternum, well below the clavicle, and be conspicuously displayed.

The skin and subcutaneous tissue along the line of incision is infiltrated with 1:200 novocaine (Fig. 9), after which the incision is made without holding the skin, by a free but *not rapid* sweep of the knife, keeping the eyes on a natural fold,

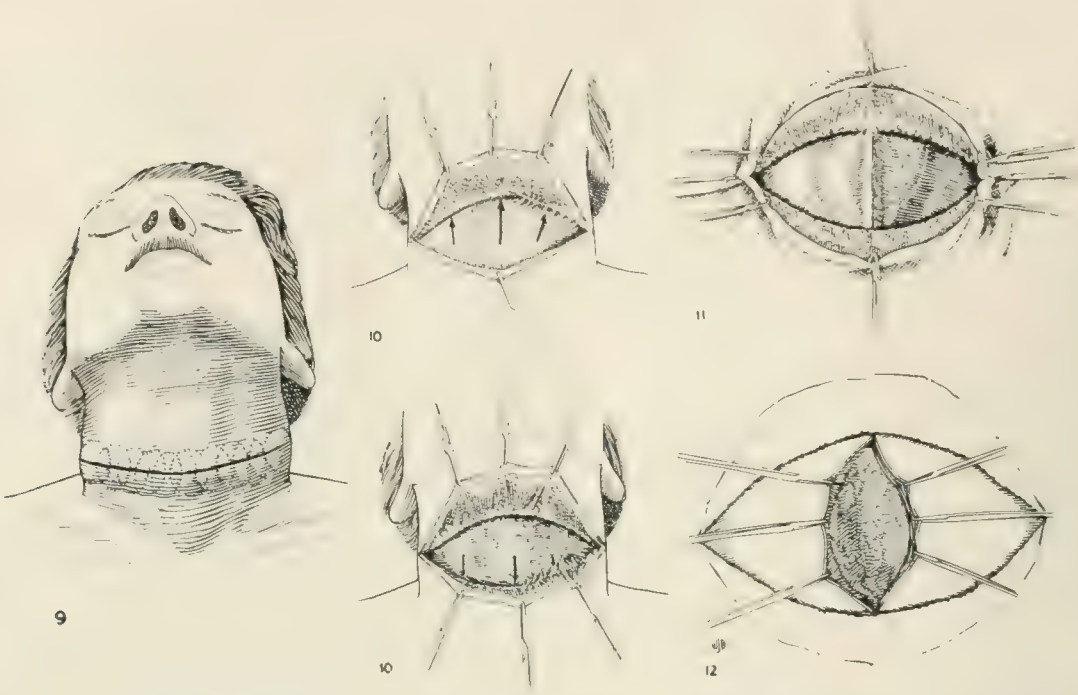

Fig. 9. Typical thyroidectomy. Correct line of incision through area which has been infiltrated with novocaine.

Fig. 10. Typical thyroidectomy. Division and reflection of skin.

Fig. 11. Typical thyroidectomy. Vertical incision along infiltrated line in preglandular muscles. Skin flaps protected by tetra cloths.

Fig. 12. Typical thyroidectomy. Vertical division of preglandular muscles exposing gland.

or failing that, upon the line of junction of the neck and chest.

The most common error is to make the incision too low, especially if the goiter protrudes prominently in the front of the neck. The shortcoming of the so-called necklace incision is that an ordinary ribbon or band will not cover it as in the case of the higher incision. In addition, if the incision is made in the manner just described, a covering will rarely be required. Under no circumstances should the incision be made in a vertical direction.

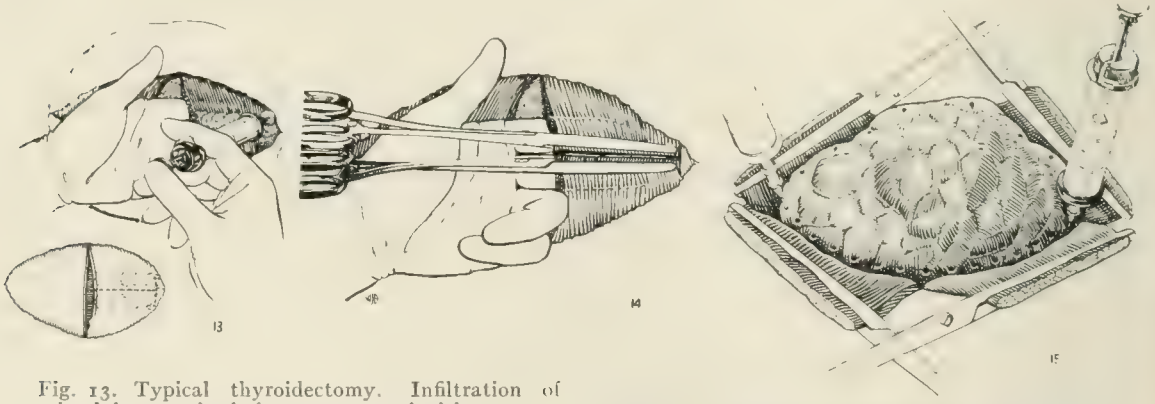

Fig. 13. Typical thyroidectomy. Infiltration of preglandular muscles before transverse incision.

Fig. 14. Typical thyroidectomy. Transverse division of preglandular muscles between clamps.

Fig. 15. Typical thyroidectomy. Infiltration of gland with novocaine.

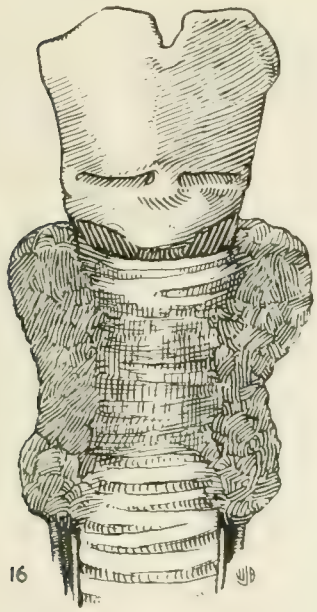

Fig. 16. Typical thyroidectomy. Posterior portion of gland which is left after thyroidectomy. Note thin layer of tissue covering trachea.

The platysma muscle is divided and reflected with the skin (Fig. 10). Formerly, in perhaps a thousand cases, we made a separate dissection and suture of the platysma but further experience showed that this is unnecessary for if the platysma is attached to the skin, it will be approximated with the skin if clips are used, and if the platysma remains with the preglandular muscles it will be approximated with them. In either case it will function normally. In other words, no attention is paid to it.

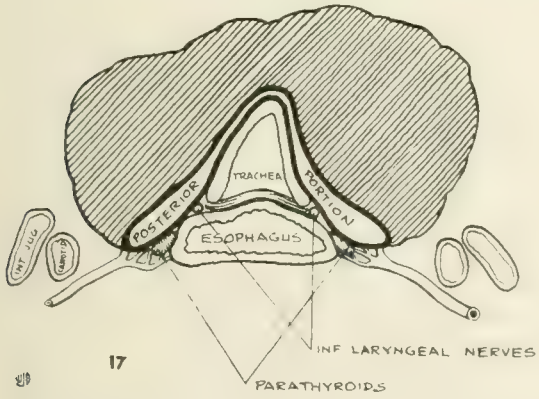

Fig. 17. Typical thyroidectomy. Schematic drawing in which shaded area represents portion of gland that is removed.

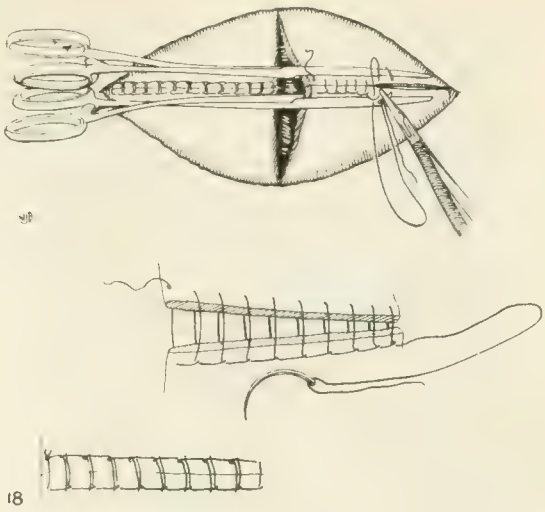

Fig. 18. Typical thyroidectomy. Suture of preglandular muscles with buttonhole stitch.

Preglandular muscles. Shall the preglandular muscles be split vertically and their margins drawn back by retractors or shall the preglandular muscles be divided transversely, thus completely exposing the thyroid, giving the opportunity of making the operation of resection under the eye without the need of retractors to pull back the muscles? In the case of small goiters, the vertical division will answer; but in the great majority we have found it best to divide the muscles transversely. The transversely divided muscles become so soundly healed that no later disability occurs. The preglandular muscles, on one or both sides as required, are therefore divided between transversely applied special clamps after the line of incision and the areas to be grasped in the clamps have been completely

Fig. 19. Typical thyroidectomy. Vertical closure of preglandular muscles.

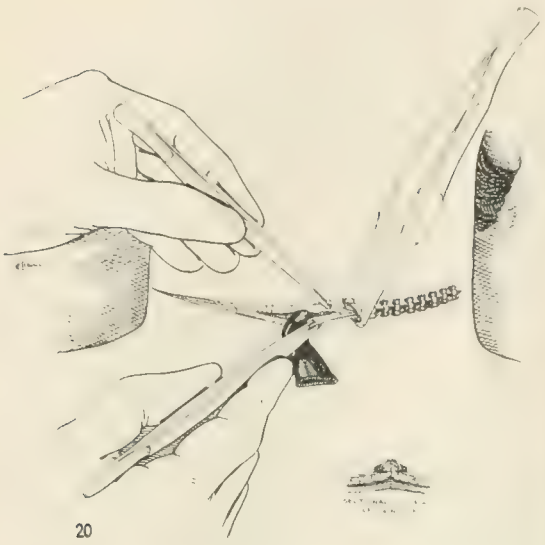

Fig. 20. Typical thyroidectomy. Closure of skin incision with clips.

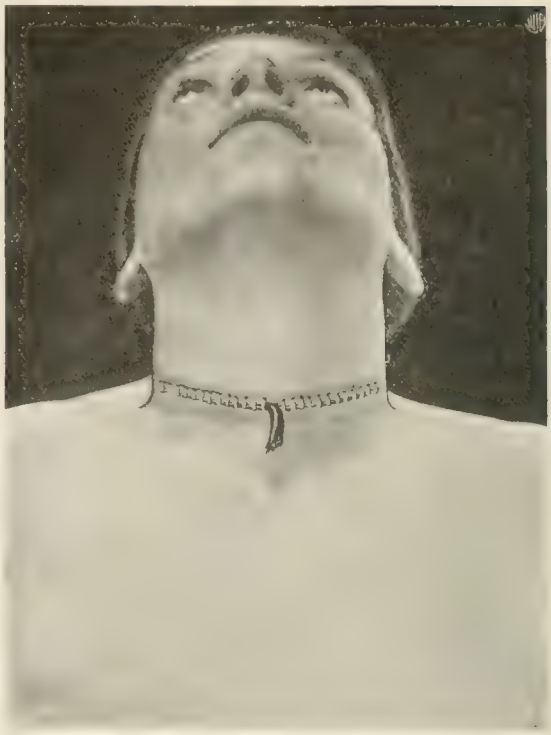

Fig. 21. Typical thyroidectomy. Appearance of incision after closure.

infiltrated with novocaine. These muscle clamps are especially designed for this purpose. They grasp and hold, but do not crush the muscle (Figs. 11 to 14).

The advantages of the muscle clamps are of the first order, for they completely control bleeding, their handles serve as retractors, and they cause almost no tissue injury. By means of the four muscle clamps holding the divided muscles, the structures overlying the goiter are unfolded. After the neck has been opened, the skin and platysma myoides are protected by a sterile tetra cloth. If more room is required than is provided by the transverse division of muscles, then in addition vertical incisions are made in the muscle at the outer end of the transverse muscular division.

Blocking of the gland with novocaine. The capsule and the entire portion of the gland which is to be removed are infiltrated freely with 1:200 novocaine (Fig. 15). In exophthalmic goiter, in particular, the infiltration of the gland with novocaine is of prime importance because there is evidence that the thyroid discharges its secretion quickly in response to nerve stimuli. Novocaine blocks the sympathetic nerve impulses, just as it blocks the impulses of the nerves of common sensation. Care must be taken not to include the recurrent nerves in the infiltration. The superior pole in particular is well infiltrated. If care is exercised there is no danger of puncturing vessels nor of novocaine intoxication. We have not seen a single instance of intoxication in our series.

Superior thyroid artery. In thyroidectomy the superior thyroid arteries are isolated and ligated to prevent their retraction and the resultant difficulty of catching and tying them. If catgut is used it should be made secure by passing it around the artery with a needle. If a free tie is made with catgut then in the case of vomiting or coughing the ligature may slip off. If a free tie is to be made, the ligature should be silk.

Resection of the gland. In the resection of the gland itself as in the preliminary steps, the points of prime importance are the maintenance of a clear field and the absolute surgical control of every phase of the operation. A margin of thyroid tissue is left along each lateral border from the upper to the lower margin of the gland (Figs. 16 and 17). To leave this margin it is necessary to carry the division through the most vascular part of the gland. Hæmorrhage is prevented by first grasping the tissue in Halsted forceps, then dividing it. Many forceps are required. The forceps are tied off afterward with catgut on a needle. The remainder of the lobes and the

Fig. 22. Interrupted operation. Wound packed with flavine gauze.

Fig. 23. Interrupted operation. Deep infiltration of subcutaneous tissues before removal of flavine gauze.

Fig. 24. Interrupted operation. Infiltration of muscle flaps with novocaine before suture after delayed operation with interim packing with flavine gauze.

isthmus are removed, usually in a block. The division of tissue is made with a sharp knife in a field so clear that the parathyroids and the recurrent nerves would be seen before they were injured, although in practice they should never be seen, for if they are exposed, the œdema, and later the scar, may interfere with their function, this interference being expressed by tetany and hoarseness.

The trachea. The line of cleavage across the trachea and the larynx is developed in such a way that an undisturbed covering remains to protect these structures. Under no circumstance is the surface of the trachea or larynx touched by a forceps. A connective tissue covering of the trachea and larynx is always left, for if the sensory nerve on the surface of the trachea or larynx is disturbed the impulses are registered in the brain as coming from the inside of the trachea—therefore coughing and mucus are produced. After the front of the trachea and larynx have been crossed, then as a rule all the vessels held by the forceps (light Halsted's) are tied and a warm, moist, gauze sponge is laid on the field.

After the right lobe and isthmus are completely separated, and the attachments of the left lobe to the trachea and of the upper pole to the larynx are divided so as to clear the trachea and larynx, the left lobe will be so greatly mobilized that the forceps grasping the vessels may be used to displace the lobe so as to bring the line of proposed division of the lateral thyroid tissue clearly under the guidance of the eye. The lateral lobe is then divided bloodlessly and without bringing into vision the parathyroid or the recurrent nerve. If at any point the patient is disturbed, additional novocaine is at once infiltrated. The entire field is inspected to determine whether or not too much thyroid tissue has been left; and whether or not any vessels have been overlooked. If these points are satisfactory the anæsthetist raises the head of the patient; and the divided preglandular muscles are brought in apposition by means of the handles of the compressing forceps. The muscles are united carefully by means of a buttonhole stitch made with a curved needle and catgut (Fig. 18). When both sides are thus closed, the wound is finally inspected for bleeding. Then the vertical incision is united by suture, a small drain is inserted, and the skin is closed with clips (Figs. 19 to 21). The drain is removed the following day.

Occasionally in a hazardous case of exophthalmic goiter, the operation is stopped after the removal of one lobe, or at any point the condition of the patient may indicate, and the wound dressed with flavine or sterile gauze (Fig. 22). The next morning, if conditions are favorable the operation is completed and if the condition of the patient is favorable at the close of this shorter operation the entire wound is closed (Figs. 23 and 24). However, if the condition the next morning does not warrant resection of the second lobe, the wound is closed under analgesia and local anæsthesia and the patient sent home for a period of controlled rest, the second lobe being removed at a later date. If, after the second lobe is resected on the morning after the first operation, the patient's condition is in doubt, a flavine dressing is again applied and the wound finally

closed in the afternoon of the same day or the following morning, according to indications.

As the result of the employment of the technique described above, together with the preoperative and postoperative plan of management which has been described elsewhere, the mortality in the last 1783 thyroidectomies including 1022 for exophthalmic goiter, has been reduced to 1.4 per cent; in the last 783 ligations to 0.76 per cent.

CLOSURE OF LARGE HERNIAL DEFECTS IN THE UPPER ABDOMEN

By ROBERT EMMETT FARR, M.D., F.A.C.S., Minneapolis, Minnesota

THE closure of defects in the abdominal wall has presented difficulties to surgeons and many ingenious methods have been devised in an effort to bring about a cure in this class of cases. Silver wire, silver chain, linen, silk, plastic methods, and the introduction of grafts of bone and fascia have been utilized—the most satisfactory perhaps being the transplant of fascia lata from the thigh. While in the absence of infection these grafts, as a rule, live and heal in place, their nourishment must come from surrounding tissues, thus placing a rather severe strain upon one's asepsis. The presence of slight infection is apt to be inimical to success. It would seem desirable to use, whenever possible, a transplant of fascia or fascia and muscle combined whose circulation is not entirely cut off.

The following cases, presenting defects in each instance larger than one's open hand, permitted the writer to make use of the method described below, and in each instance resulted in a perfect closure of the defect.

Case 1. Mrs. M., age 55, weight 250 pounds, extremely adipose. I operated upon this patient in 1905 for cholelithiasis, a cholecystostomy being done. In May, 1914, a large amount of gangrenous bowel was turned out through an incision at the ninth costal margin on the left. A resection was done later, with a lateral anastamosis of the colon, drainage being required. A year later the gallbladder was removed on account of cholecystitis and cholelithiasis. There was practically no muscular tissue left in the upper abdominal wall and a hernia resulted over the area shown in Figure 1 (No. 1) and in Plate I.

The next fall I operated upon her for repair of hernia. The abdominal cavity was opened by an incision 12 inches in length, and the edges of the aponeurosis identified. The visceroparietal adhesions were carefully freed and all raw surfaces excluded. There now presented a defect 4 inches in width and approximately 10 inches long, extending from one costal margin to the other and well below. A vertical incision was made over the sternum, and the sheath of the pectoral muscles exposed as high as the nipple line (Fig. 1, 2). A quadrangular flap 10 inches long with the base below and composed of pectoral fascia and a considerable amount of muscle was dissected downward until a flap approximately 6 inches in width had been raised. This flap was then sutured over the hernial opening, chromic gut being used.

Case 2. Mr. L., age 73, operated upon January 15, 1921. This patient had had six operations in the upper abdomen by other surgeons for alleged gastric trouble, and presented a large hernia extending from the umbilicus to the ensiform, the defect being about 4 inches wide and 6 inches long. Patient had suffered extreme distress upon taking food and belched continually.

Operation. The aponeurotic edges were freed, the visceroparietal adhesions liberated and all raw surfaces carefully covered. In this case there was no parietal peri-

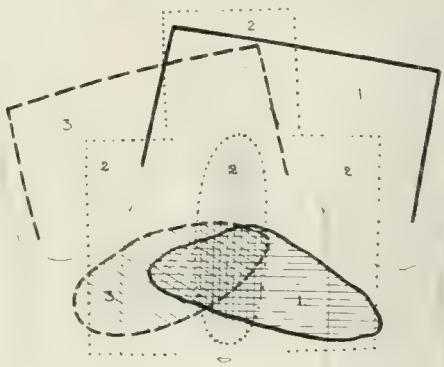

Figure 1. A composite drawing of Cases 1, 2 and 3, shows the relative size and position of defects, and also the approximate size of pedicle flaps and locations from which they were obtained.

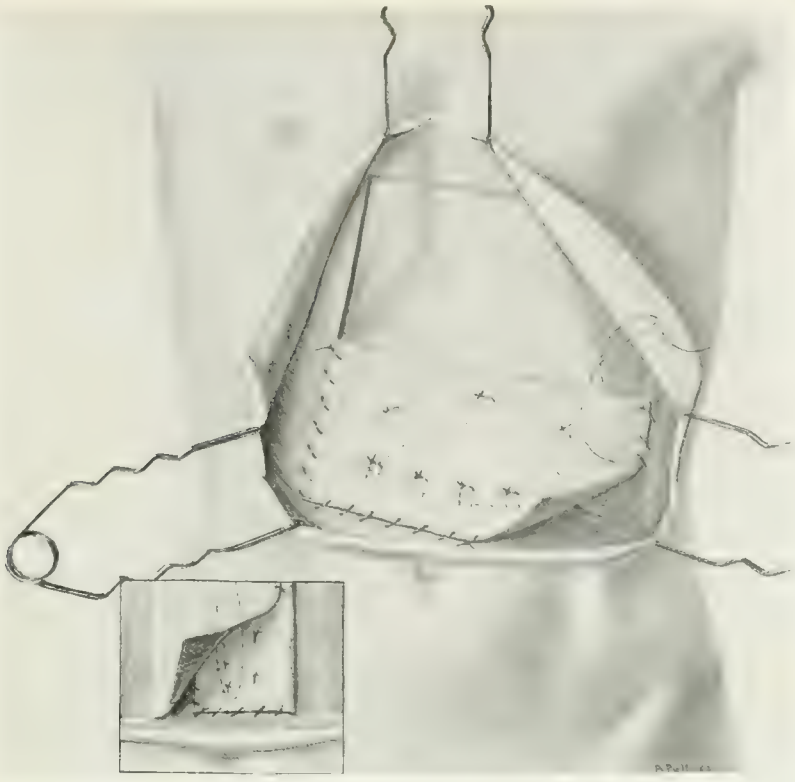

Plate I shows operative procedure carried out in Case 3 and pedicle flap turned down from the thoracic wall.

Insert shows procedure carried out in Case 2, showing pedicle flaps procured from the aponeurosis of the external oblique.

toneum with which to close the abdomen. After the application of tension sutures the incision presented a defect 4 by 6 inches. The procedure illustrated was carried out. The flap taken from the chest wall was applied to the upper portion of the defect. The aponeurosis of the external oblique was employed to complete the closure (Plate I). A pedicle flap with a mesial base was turned in from either side and overlapped at the mid-line. This patient has remained entirely well and is greatly improved symptomatically.

Case 3. Mrs. W., age 50. On April 22, 1920, a cholecystostomy was performed for the relief of chronic jaundice due to an impacted stone. On May 9, the patient developed severe hæmorrhage from the wound. Blood transfusion increased the clotting time of the blood and a massive pack prevented further hæmorrhage. Subphrenic abscess with infection of the pleura was diagnosed on June 3. Posterior drainage with rib resection. Lung abscess developed on May 18 so that the patient had communication between the bronchus and the opening in the abdominal wall. Patient slowly recovered and returned to the hospital on March 30, 1921, for repair of a massive incisional hernia which had taken place through the L-incision for the original gall-stone operation.

Operation. The abdominal wall presented no muscular tissue, and a fair amount of tension upon the aponeurotic edges left a defect approximately the size of one's hand (Fig. 1, 3). In this case a rectangular flap with the base lying along the costal margin, its lower portion utilizing the upper part of the external oblique on the right, was turned down from the chest wall and with it the defect was effectually closed (Plate I).

In each of these cases drainage was employed for 24 hours, and in Case 3 a slight suppuration took place at the upper angle of the wound. The patient, however, apparently has a splendid abdominal wall, although the time is too short for one to feel at all certain about a permanent result.

The lower portion of the thorax furnishes one with the ideal conditions for the procuration of a pedicle flap as the protection of the ribs furnishes adequate insurance against the possibility of weakening the area from which the flap is obtained. The pedicle-flap method, provided flaps can be obtained without too greatly reducing the strength of the area from which the flaps are obtained, may be effectually applied to ventral hernia in any part of the abdominal wall.

TREATMENT OF FRACTURE OF THE NECK OF THE FEMUR WITH THE ABDUCTION TRACTION SPLINT

By L. S. KEMP, M.D., Canton, Massachusetts
Assistant Physician Massachusetts Hospital School

THE results of our previous treatment of fracture of the neck of the femur have been unsatisfactory as a whole and this is reflected somewhat in the attitude of the friends and relatives of our patients who, upon learning that one of them has suffered this accident, expect a long period of invalidism or ultimately death.

The treatment generally used is the application of a plaster-of-Paris spica from toes to chest after the injured leg has been brought to full abduction and extension with a few degrees of internal rotation. By this procedure the ends of the fractured parts are forcibly placed in apposition, the probability of soft tissue being lodged between the ends of the bones is minimized, and the position is maintained fairly well.

The disadvantage, which is a very great one, is the fact that the patient is forced to spend a considerable length of time recumbent in bed and is unable even to move without assistance. In every case, especially those of advanced age, this factor plays a most important part; as you always have present the possibility of hypostatic pneumonia, bedsores, or sloughs, which quite often go unobserved for long periods under the most skilled care and the general atrophy which a part undergoes while encased in plaster.

By raising the head of the bed, the first objection can be only partially overcome as the patient's movements are, of necessity, very much restricted and the circulation becomes sluggish. This in turn does not give the lungs an opportunity to function properly and at the

Fig. 1. Fig. 2. Fig. 3. Fig 4.

Fig. 1. Case 1. Roentgenogram taken at time of injury.
Fig. 2. Bradford splint applied.

Figs. 3 and 4. Show condition of patient at time of discharge, almost 4 months after injury.

Fig. 5. Case 2. Roentgenogram taken at time of injury.

same time reduces the blood supply of the affected part with its resultant impaired nutrition. Prompt and satisfactory repair cannot take place without good nutrition of the part which necessitates the normal action of the circulation and other functions of the body.

The second objection is that bedsores or sloughs often occur under the plaster with little or no discomfort or pain and are not discovered until much damage has been done. This condition can, in a large measure, be prevented by suitable padding and skilled application of the plaster which, of course, keeps the nurse from keeping the skin in the healthy condition which is so invigorating to the patient.

The third objection to the plaster support is that of general atrophy. I say general atrophy because it is not confined alone to the muscles but to all tissues including bone. The diminution in lime salts is more rapid under plaster support than with any other, a condition which tends to delay firm union. The muscles lose their tone, the capsule and ligaments about the hip-joint become contracted and cicatrized and when the patient is removed from the plaster the hip is either ankylosed or allows only the slightest motion. The manipulation and massage necessary to re-establish motion in the hip must be continued for an extended period with more or less discomfort to the patient and the return to normal is at best a slow, tedious process.

On February 18, 1918,[1] Mrs. H., a woman 63 years old, employed in the serving room of the Massachusetts Hospital School, had the misfortune to slip on a wet floor falling very heavily. The patient was seen by the resident staff within a few minutes after the accident and a diagnosis of fracture of the neck of the femur was made. At this particular time the Medical Advisory Board of this district was holding its meeting here and each member concurred in the diagnosis. The patient was removed to the infirmary, an X-ray taken and she was made as comfortable as possible upon a frame with traction applied to the injured leg (Fig. 1). A member of our consulting staff saw her within a few hours and owing to her age and general physical condition, it was deemed inadvisable to encase her in plaster, as we feared she would not tolerate the long period of recumbency which would be necessary.

Having in mind the excellent results which have been attained at this institution and at the Children's Hospital in the treatment of caries of the hip by means of the Bradford abduction traction splint, it was felt that this apparatus would be of value in this case. Measurements were taken, the splint finished and applied on the second day (Fig. 2). The patient was then told that she could move about in bed as she wished and as the hip was held firmly in a good amount of abduction with moderate traction, she was perfectly comfortable.

At the end of the first week she began to sit up at meal time and at the end of the second week was able to sit up on a couch, part of the day. A high sole was made for her, broad on the walking surface so that it was very stable. During the third week she spent a few minutes each day in the walking frame and by the end of the first month was spending several hours a day in the same apparatus.

At no time was any great discomfort felt in the hip and she soon learned to manage the splint. By the end of March (7 weeks) she was walking, with the aid of crutches, all about the ward and on pleasant days went out of doors for a few minutes. Fifteen days later, the X-ray showed very good union, traction was removed and she continued to wear the apparatus as a convalescent splint. April 30, 1918, she began sleeping without her splint, 10 days later it was removed for half an hour increasing the time by a half-hour each day and she continued the walking and had daily massage of the leg.

On May 18, 1918, 3 months after the injury, the splint and high sole were removed; but the patient continued walking with the aid of crutches. June 9, 1918, she was discharged from the infirmary, able to walk several hours a day without apparatus of any kind. Examination at discharge showed no shortening, as contrasted to the one-half inch she had at the time of the accident, practically full motion in all directions and with no perceptible limp (Fig. 3 and 4). At the time of writing this article Mrs. H. seems in good health for one of her age, and until a few months ago was employed as matron in one of our large halls.

The abduction splint not only holds the hip in any desired degree of abduction but gives fully as much, if not more, fixation than the plaster-of-Paris spica. Of greatest importance is the

[1] See New York M. J., 1919, November 22.

fact that it allows the patient to move about at will, permits early locomotion and the entire skin surface of the patient can receive daily attention without disturbing the adjustment of the splint. Following the application of the splint at the end of the second week, the patient is encouraged to attempt walking, with assistance, and is given a high sole, thick enough so that the bottom of the splint swings clear from the floor. With this treatment, the patient's general condition remains good throughout, the time required for treatment is reduced to the minimum and the amount of massage necessary to restore the muscle tone and normal motion in the hip is practically negligible.

I wish to report at this time two other cases treated with the same type of splint with equally good results. The diagnosis in each case was confirmed by careful X-ray and the treatment followed by those not specially trained in the care of this splint, yet no difficulty was encountered.

Case 2. Mr. J., 50 years old, was knocked down by a bicycle on April 10, 1920, and removed to a general hospital. Figure 5 shows condition at time of injury. I was called to see him the next day and 4 days after the accident an abduction traction splint was applied. One month later, being able to walk somewhat with crutches, he was discharged from the hospital. He continued his treatment at home and on June 5, 1920, 1 week after traction was removed all apparatus was discontinued. I quote from a letter received from him October 28, 1920: "There is practically no stiffness in the hip at the present time, the trouble being some stiffness in the muscles of the leg. I might also add that I have been doing my regular work in singing since September, 12, 1920. At present time use one cane occasionally." At time of writing he walks with a very slight limp, is on his feet a good part of the day and has not used a cane for several weeks.

Case 3. Miss T., age 49, fell September 11, 1920 producing a fracture of the neck of the right femur and was sent to a general hospital. A week later an abduction splint with traction was applied and at the end of 2 weeks she was beginning to walk a little with the aid of crutches. In about 1 month she was discharged to her home where she continued to walk more each day. November 18, 1920, the traction was discontinued and she discarded her splint entirely December 21, 1920. March 14, 1921, I received a letter from Miss T. in which she stated that she had just discontinued the use of crutches and that she was now walking with the aid of a cane. Her hip gave her little difficulty but the muscles of her thigh and leg were somewhat stiff.

ELECTRICAL BREAST PUMP[1]

By BERTHA VAN HOOSEN, A.B., M.A., M.D., Chicago
Professor and Head of Obstetrics Loyola University Medical School

THIS breast pump is made by assembling the smallest size teat cup manufactured by the Success Milker Company, Milwaukee, Wisconsin, and the electrical suction apparatus used by surgeons for aspirating blood or fluids during an operation. The teat cup is connected with the suction apparatus by heavy, non-compressible rubber tubing and glass U-tubes. In place of the more expensive electric aspirating apparatus the water suction apparatus is quite as effective and more adaptable to home use, but when the patient is in bed, it may require quite a length of rubber tubing to reach from the bed to the nearest water faucet. The length of tubing takes away a certain amount of force from the apparatus and is unwieldy to manage. The price of teat cups, rubber tubing, and electric suction apparatus is approximately fifty dollars, while the price of the instrument with the substitution of the water suction apparatus is about ten dollars.

The superiority of this electrical breast pump over the ordinary hand breast pump is that the suction is steady and the power is four times as great. Mothers make no complaint when it is used; on the contrary many assert that the sensation is agreeable. This pump has been in use at the Frances Willard and Mercy Hospitals, Chicago, since last September, and has had a trial in enough cases of flat or retracted nipples to warrant the statement that it is a cure for the deformed nipple. No case of retracted nipple has been met where the baby was not able to grasp the nipple easily after the pump had been applied to the breast for from 3 to 5 minutes. Before attempting to remove the teat cup from the nipple do not forget to turn off the electricity and disconnect the tubing so as to permit a break in the vacuum. It is better to allow the mother herself to remove the cup.

It is recommended that the pump be used by routine twice a day, beginning within 6 hours after delivery, and continued daily while the patient is in the hospital. On the first day the pump is used not longer than 5 minutes and before the baby is put to the breast. The use of the pump

[1] Read before the Chicago Gynecological Society, May 20, 1921.

Photograph of author's electrical breast pump.

on the first day is for the purpose of stimulating the secretion of milk, cleaning out the milk ducts and enlarging the nipple. After the first day the pump is used night and morning immediately after the baby has finished nursing and is kept on the breast for from 5 to 15 minutes or long enough to insure the breast being soft and flabby and perfectly empty.

This treatment is designed to enlarge and develop the nipple, to stimulate early milk secretion, and to bring the breast up to a greater milk production than would be otherwise possible. Where milk is daily retained and absorbed it is only a short time before scarcely enough for the needs of a delicate week- or month-old baby will be secreted, and when the need of the baby is greater it will be impossible to raise the secretory power of the breast. If the baby is gaining, the milk that is pumped out night and morning is used for some under-nourished infant. If the baby is not gaining, the milk is given to it in addition to the nursing.

As an example of what may be accomplished with the pump, we have record of one patient who was confined in the Frances Willard Hospital, Chicago, in February, 1921. The baby weighed 7 pounds and 4 ounces at birth. The electric pump was used night and morning according to the plan previously suggested. After the third day the mother furnished an average of 8 ounces of milk daily above the needs of her baby and at the same time the baby's weight on the thirteenth day was 8 pounds and 4 ounces, or a gain of 1 pound above its birth weight.

If these pumps could be installed at centers throughout a large city so that mothers could go night and morning and sell their surplus milk we might do much in solving the infant-feeding problem. The requirements that would have to be made regarding the Wassermann and tuberculin test for mother and child and the attention that would be necessarily given to the gain in weight of the mother's own baby would be invaluable aids to the infant welfare workers. The price that could be put on healthy mothers' milk would be such that a baby in a poor family would no longer be a serious financial handicap, but a commercial asset.

TRAUMATIC SYNOVITIS OF THE KNEE JOINT AND ITS TREATMENT

By Lieutenant Colonel R. F. METCALFE, M.C., U.S.A., F.A.C.S., Fort Sam Houston, Texas

MY Army experience has caused me to have a great respect for knees and their trauma. We all know how often a seemingly slight contusion, twist, or wrench, or fall on the knee is followed by a long-continued effusion, frequent recurrences of swelling, and a permanently damaged knee.

In the past I have often treated soldiers' knees in the approved manner as described in all textbooks: by rest, in the partially flexed position, by the application of ice caps early, pressure bandages, and heat later. Some were fortunate and recovered, others, after 3 to 6 weeks' treatment would be sent to duty and after a hard march would return to hospital with an effusion in the same knee. Many such patients continued to report at sick call with these now chronically swollen knees. Often their complaint was so bitter that it became necessary to issue discharges on certificate of disability.

In 1916, while on the surgical service at Fort Sam Houston Base Hospital, I decided to aspirate effused knee joints, and give the joint structure complete rest by extension. I had the carpenter make me some inclined planes with a long leg 36 inches long and 18 inches wide and a short leg 18 inches long and 18 inches wide, joined at a right angle, with a brace on either side; a trough 5 inches deep and 6 inches wide at the narrow end, 8 inches at the wide end. A hole was made in foot end for an extension rope, with a floor standard adjustable as to heighth, with an iron wheel for rope, with a sand bag on the end. The purpose of the trough was to keep the leg from contact with the inclined plane and thus lessen friction, giving the maximum extension at all times. During that year, I aspirated something over one hundred and fifty knees, and extended them. With very few exceptions the joints became normal and the men were ready for duty in less than 2 weeks, usually 11 days. During this treatment one observation made was that a traumatic knee aspirated a few hours after the injury invariably showed practically free blood, after 6 days a bloody serum, and after 10 days, a straw-colored serum.

One patient who had repeated effusions in his right knee with an original traumatic history, seemed so hopeless that I made a lateral incision and by pressure over the synovial sac expressed more than twenty loose bodies resembling cartilage and varying in size from that of a dime to a silver dollar. Examination of these bodies showed the substance to be fibrin. After removal of these, the patient made a complete recovery.

This indicated to me the cause of the delay in recovery and the frequent recurrences in cases treated by splint and pressure; these fibrinous masses were the remains of a bloody effusion, which had not been aspirated, but allowed to remain in the synovial sac. The fluid parts of the blood were absorbed and the fibrinous part was deposited in the joint until there were formed organized loose bodies and these caused a constant irritation and effusion of synovial fluid, whenever the bodies were pinched. This in turn caused joint stretching.

During 1916, I aspirated all joints immediately upon their admission to the hospital and put them up in extension. More recently, I have found that some of the effusion re-accumulated in the synovial sac and therefore I have made it a practice to wait about 48 hours after the injury. This gives the bleeding points in the synovial sac a chance to coagulate and after aspiration and extension, there is very rarely a re-accumulation of the effusion. The apparatus used for extension is a simple affair and is well shown by the accompanying cut. It can be made in a short time by any carpenter. We have eight of them at this hospital and they are constantly in use. The method of aspiration is simple, as will be seen from the description.

The patient's leg is shaved from the knee down in order that adhesive straps for extension may be applied along the sides of the leg. The entire knee is given two coats of 3.5 per cent iodine, and then carefully covered with sterile towels. No anæsthetic is used, as the pain is slight. An assistant grasps the lower end of the thigh, and the upper end of the leg above and below the knee and makes a steady pressure bulging the synovial sac. A medium-sized needle on a 30 cubic centimeter Leur glass syringe is inserted on the inside of the knee just behind the patella. In many cases, we find the tension is so great that it forces the plunger of the syringe upward. When the syringe is filled, usually with a bloody serum, it is detached from the needle and emptied in a graduate. The aspiration is continued until no more serum or blood is obtained. The needle is withdrawn, and the needle hole is sealed with

collodion. The extension straps are applied to the sides of the leg from the knee down, and the ankle is padded. The leg is then put in extension, on the inclined plane. (At this point, it might be well to state that the Thomas splint is not a satisfactory apparatus for obtaining the extension.) In more than 300 cases treated, as above, we have withdrawn from 60 to 100 cubic centimeters of bright blood or bloody serum. In 9 or 10 days, the extension is removed, and the patient is allowed to get up and to start walking. In a large majority of cases, this ends his treatment. He is returned to duty by the end of the thirteenth or fourteenth day and does not come back on account of further swelling of the knee.

Even though we are reasonably sure of a dislocated cartilage, this method has been followed, as it gives the part the needed rest, and after the swelling has subsided, which it does rapidly, the diagnosis of loose cartilage can be made, and in many cases, no further treatment will be required. Withdrawal of the blood from the synovial sac eliminates the possibility of a deposit of fibrin and we believe that in a simple case of synovitis, we can expect 100 per cent recoveries.

Of course, it is admitted that many cases of simple effusion into the knee joint will recover with rest, with the application of ice early and of heat late, and with pressure. We do know, however, that every effusion which is the result of trauma is bloody and that unless the fluid is removed by aspiration, fibrin will be deposited in greater or lesser quantities and there will be formed organized foreign bodies. These foreign bodies will be constant irritants, and the condition will become chronic.

After aspiration, the dimple or depression on the inner side of the knee appears and during extension remains visible and the patient leaves the hospital with a normal knee. With any other

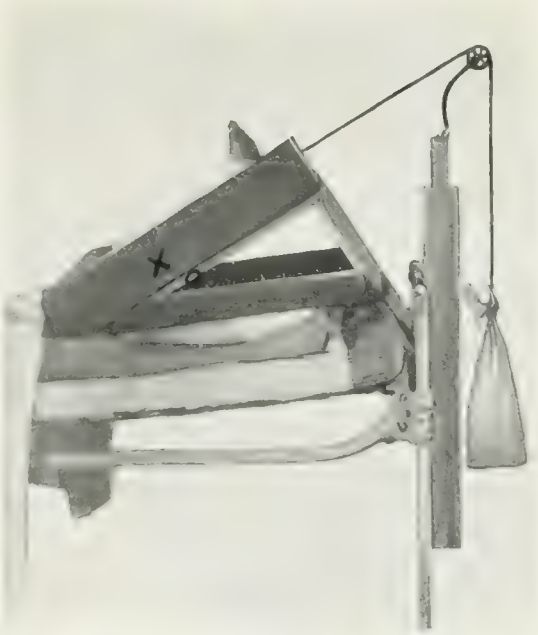

Fig. 1. *x*, Trough, which slides on *o* incline.

form of treatment, at least one-half of the patients even though there is a subsidence of swelling, go out with permanently damaged knees.

The method is simple, the results are most gratifying. In more than 300 cases treated of all degrees of trauma, I have not had a single infection. Less than 25 cases have required a second aspiration, and all cases, unless due to an actual structural damage in the joint, have recovered completely and promptly on an average of 10 days.

The only objection that can be raised against this treatment is the enforced period in bed, but we believe that a perfect knee joint is well worth 10 days of any one's time.

TREATMENT OF PREGNANCY COMPLICATED BY VALVULAR HEART DISEASE[1]

By N. SPROAT HEANEY, M.D., F.A.C.S., Chicago

"NO girl with a mitral stenosis should be allowed to get married, let alone have children," was a statement which I heard as a senior medical student but which I have since learned to discredit through the leavening of experience. That many women with cardiac disease who might have lived as spinsters to a ripe old age, have had their lives shortened, have become prematurely invalided, or have died because they willingly or unwillingly have become mothers, is known to any physician of experience. This does not mean, however, that all women who have heart lesions have such a future to fear in the event that they wish to undertake motherhood. Routine examination has shown that probably the lesser half only of such women develop symptoms indicative of bad heart function, and of these only a small percentage come into acute danger, while the larger percentage behave much the same as if no heart lesion existed. Many of those women who have fortunate outcomes of their pregnancies are those in whom the heart lesion might be said to exist accidentally. The history frequently fails to reveal the nature of the infecting disease and often no index exists as to when the lesion may have been acquired. Most of such patients have never had symptoms which might be brought into association with the lesion and search into the history usually elicits surprise on the part of the patient that the condition of the heart should be under suspicion. Such women are strong and well except for the presence of abnormal heart sounds. No myocardial degeneration exists and their hearts are perfectly compensated and are equal to the strains of their pregnancies.

Those women who die or become cardiac invalids as a result of pregnancy in a considerable percentage of cases give a history of a serious illness back in infancy or girlhood, with prolonged confinement in bed afterward, perhaps even with subsequent periods of weakness, or shortness of breath upon moderate exertion, or suggestive or actual attacks of broken compensation. If moderate exertion brings on cardiac symptoms, pregnancy is certainly inadvisable. If broken compensation has occurred at a time subsequent to the initial acute illness, then pregnancy would be a grave undertaking, indeed, since broken compensation is almost certain to occur. That a woman who is conscious of her heart or who has been under treatment because of undoubted heart disease, or who gives a history of one or more attacks of broken compensation, should be warned regarding the probability of trouble in the event of pregnancy; or, if such a patient should become pregnant, that she should be considered as a grave responsibility by her obstetrician, are positions which it would seem are well taken.

To advise a patient in full health, however, simply because she has abnormal heart sounds, that pregnancy is a grave danger to her, is amply proved false advice by the study of completed case histories on a hospital service where full data of physical findings are recorded. That such a patient runs no risk on account of her heart, can also not be said if for no other reason than that there is always the chance that a weak myocardium may exist though thus far not detected. It may await only the peculiar conditions of pregnancy to make itself manifest.

The straining and retching of vomiting in the early months is frequently so extreme a test of heart competence that a heart breaks down which would have been sufficient for the usual tax of pregnancy or even of a moderate labor. An elevated blood pressure should be viewed with unusual interest and early steps be taken to counteract its malicious effect. Twin pregnancy or hydramnios may bring to an unsuccessful conclusion a pregnancy which under normal conditions might readily have resulted in a viable child. Slight disproportion between child and passage becomes magnified in the cardiac patient and is a complication of much importance. We can understand these more or less mechanical effects produced by certain phases of pregnancy, but it is hard to understand the occasional case where, for no reason that can be weighed except that the patient is pregnant, a heart becomes worse almost as soon as pregnancy starts.

A pregnant woman presenting herself for obstetrical attention with a symptomless heart lesion should be encouraged to believe that with careful observation and average good fortune she can expect to have her child at not unreasonable risk. Since not even the soundest woman can be guaranteed more, the physician must

[1]Read before the Chicago Gynecological Society, May 20, 1921. (For discussion, see p. 281.)

not make the cardiac patient's pregnancy more dangerous to her by injecting the element of fear to embarrass her. A quiet mind and sanguine attitude are helps of the greatest moment. Undue strains are to be pointed out, plenty of sleep and rest are to be secured, avoidance of dietary indiscretions is to be insisted upon, and frequent blood pressure and urine examinations are to be made. As long as the patient is absolutely well, the normal course of pregnancy is to be traveled. Toward term, special attention should be given to the proportion existing between mother and child. When once the fœtus is amply able to withstand extra-uterine life, the slightest evidence of intoxication on the part of the mother should call for the termination of pregnancy much earlier than would be indicated with the same degree of intoxication in a normal patient. When there can be no doubt of the entire ability of the fœtus to live outside, which ordinarily would certainly be within 2 weeks of term, I would consider it desirable—provided normal conditions of the soft parts obtained and if with reasonable certainty a moderate labor could be prognosticated—for labor to be induced, if possible, by such a simple procedure as separation of the membranes and the administration of castor oil and quinine. Waiting beyond the time which is secure for the fœtus means added work for the mother and the possibility of intoxication and embarrassment should the pregnancy continue.

The labor should probably be made as painless as possible in the first stage since pain, fatigue, and sleeplessness are the only elements of the first stage which could be considered deleterious to the patient. When the labor is securely induced, the judicious use of morphine, chloral, sodium bromide, or, in the hands of those who understand its use, scopolamine may greatly protect the patient's heart. In the absence of symptoms of malfunction of the heart, no digitalis seems advisable short of this time. It may be considered wise, if labor is to be anticipated, to administer digitalis long enough in advance to expect its therapeutic action to be present when labor begins.

All premature efforts at straining are certainly to be discouraged and while the patient's heart condition remains good, labor should be allowed to continue as long as satisfactory progress is made. When the expulsive stage is reached, the desire to bear down should be resisted until uncontrollable; then, if the patient is a primipara with considerable resistance, or a multipara in whom this stage is not to be rapid, a forceps delivery should be made with or without a perineotomy, according to the conditions met. When the narcotics administered early fail to keep the patient from undue suffering, gas and oxygen analgesia should be given—to be supplanted by ether for the forceps operation. If haste in delivery is synonymous with post-delivery pain and sleeplessness, delay should be the order even if at the cost of a few more minutes' narcosis or a few expulsive efforts on the part of the patient, since this added strain on the heart may be far less than the bad effect of sleeplessness and pain after labor.

If a patient who has had a recent broken compensation, or who has had several attacks earlier in life, presents herself in beginning pregnancy, the dangers to her would be considered so great that the termination of pregnancy would be advised, more especially if the heart were misbehaving in any way. Particularly would an abortion be advised if the patient were a multipara who had had a broken compensation in her preceding pregnancy. Since abortion in such a case is being done for a condition which does not improve with age, simultaneous sterilization may wisely be added if not greatly increasing the risk. In the hands of one experienced in vaginal operations such a desideratum may be nicely obtained by bringing the uterus into the vagina through a colpotomy incision, and after removing the ovum through a transverse fundal incision, sterilize the patient by exsection of the uterine ends of the tubes. If the abdominal route must be selected, the question must be answered as to whether the safety of the patient would be better conserved by separating the sterilization from the abortion and by awaiting a more favorable time for the sterilizing operation.

If the above mentioned patient is already 3½ to 4 months pregnant, since abortion has now assumed the proportions of a major operation, she would probably best be handled by carrying her on with the hope of securing a viable child before her heart condition calls for interference.

As soon as symptoms of beginning broken compensation appear, the patient is to be put to bed in the position she finds most comfortable. Rest and sleep are to be secured and digitalis administered. As long as improvement occurs, the termination of pregnancy is to be postponed. When a stationary condition is reached, if viability is so far away as not to be reasonably expected, abortion should be promptly performed. If the fœtal viability is secure because of its age and development, then the pregnancy should be terminated in this, the best condition which can be anticipated. If viability is not far

off, we may with considerable trepidation try to carry the patient on so that she may satisfy maternal cravings in return for the dangers which she is incurring. We must be ready, however, to sacrifice the fœtus if there is the slightest suggestion of the patient slipping backward, since we know that if broken compensation becomes well established, it is liable to mean death of the fœtus anyway.

How best may we terminate pregnancy for the woman who has a broken compensation in the latter months of pregnancy? Abdominal cæsarean section with sterilization under local anæsthesia seems to be a growing tendency for this sort of case now-a-days. What factors associated with labor in the normal way are particularly deleterious? There is the pain, nervous fatigue, and loss of sleep perhaps in the first stage, as well as pain, bearing down, and straining of the second stage. The sudden reduction of intra-abdominal pressure produced by the uterus losing its contents and the consequent intra-thoracic change is liable to cause a dilatation of the heart. Of these factors the cæsarean section removes only the bearing down of the second stage of labor, and if the patient is operated upon under local anæsthesia, it does not relieve her of all straining efforts. She is not free of anxiety and nervous fatigue. This is ordinarily quite as much as in labor through the vaginal tract although it may not be in action quite so long. But most important is the postdelivery convalescence. The pain and sleeplessness are exceedingly greater after an abdominal cæsarean section than they are after almost any possible operative delivery through the vaginal tract. Gaseous distention of the guts is not an infrequent sequence to an abdominal section, and the upward pressure of the intestines against the diaphragm and heart may cause most serious embarrassment. Patients not infrequently vomit, sometimes repeatedly, sometimes desperately even after a local anæsthesia. If I were a patient with broken compensation, I would more willingly take my chances with almost any other form of heart strain than I would with vomiting, for nothing can leave a sound person more exhausted and weak than a violent attack of vomiting.

When we do a cæsarean section, for some reason we picture in our minds a smooth convalescence free of the disquieting complications which we are much more liable to take into consideration when operating for gynecological conditions. Perhaps it is due to the fact that even the most experienced of us have relatively few cæsarean sections compared to the number of our gynecological operations, and in consequence we more readily forget our disquieting times. The mortality of the cæsarean section is not less than is the mortality of clean gynecological laparotomies. If patients die after cæsarean sections, then many must be seriously ill who recover. And of the seriously ill, many must have intractable vomiting, tympanites, and long sleepless nights with pain which might decide the fate of a seriously embarrassed heart. Surgeons perform necessary abdominal operations upon men with broken compensation with great trepidation. Why do we fear so little when the patient is a pregnant woman? If it is the lesser of two evils, then cæsarean section is well advised.

If labor in a woman with broken compensation were the same as it is in a robust normal woman, then the question would not be open to so much argument. Along with the other evidences of cardiac malfunction there is usually great suffusion of the genitalia and unusual softness of the cervix so that labor progresses ordinarily with unusual rapidity. I have more than a few times been shown a patient with broken compensation, and since there were no doubts as to the ability of the fœtus to survive in the event it were born, or of its ability to pass readily through the pelvis, I have separated the membranes and have returned the patient to bed with instructions that should labor start, she was to receive morphine and to be closely watched to see that rest was obtained; that as soon as dilatation was complete, the membranes were to be ruptured and the patient instructed not to try to aid the labor; and that as soon as she had expulsive desire, forceps were to be applied and the child extracted. I have uniformly been greeted by the interne on a succeeding morning with the news that "the heart woman had her baby so quickly last night we did not even have time to put her in position for the forceps delivery, let alone applying the forceps."

There is no doubt in my mind that under ordinary conditions a multipara with broken compensation is better treated by the methods as outlined above than by the classiest cæsarean section that was ever done under local anæsthesia. The sterilization can better be done when the patient is a safe operative risk, or better still, can be postponed until it is proved necessary by instructing the patient to return for it 2 weeks after the missed menstrual period, should she ever again become pregnant, at which time a combined vaginal abortion and sterilization can be performed. If even slight disproportion exists or there is reason to suspect a hard labor,

then cæsarean section seems the only way out of a dilemma.

If a woman is at or near term and has a history of previous broken compensation, but the heart thus far has behaved normally, perhaps at the worst is beginning to palpitate and to cause her shortness of breath upon exertion, or there is perhaps some ankle œdema, it is not so easy to select a method of delivery. In this case you wish to interfere before broken compensation comes. The birth canal is not soft and œdematous and in consequence an easy labor may not be awaited, but normal conditions obtain and an ordinarily severe labor may be expected. Will the cæsarean section or the induction of labor with the use of morphine and forceps as outlined above be the less likely to precipitate broken compensation? In a case of this sort the most critical individualization would be necessary to determine the proper course.

The kind of anæsthesia used in heart cases is important. Ordinarily, local anæsthesia is advised instead of general wherever broken compensation is present. I have in several instances started with local anæsthesia when I have felt quite certain that by continuing with it I was endangering the patient a great deal because of her great fear and anxiety, and especially because of her straining, so I have supplemented with nitrous oxide and oxygen analgesia (not anæsthesia) in order to get better relaxation and to relieve the patient of the overpowering fear which she experienced upon realizing that her vitals lay open to view. Theoretically, the avoidance of a general anæsthetic in the blood stream may be desirable, but practically the theoretical desirability of local anæsthesia is not supported by experience.

CONCLUSION

1. Physicians are not justified in refusing pregnancy to women with accidental or symptomless heart murmurs.

2. Women who have had recent broken compensation, or broken compensation in a preceding pregnancy, enter pregnancy greatly jeopardized.

3. Cæsarean section is not a ready and complete solution of the delivery of a woman with a broken compensation.

4. Abortion for heart disease should have sterilization added to it when this can be accomplished with but little additional risk.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D. ..... Managing Editor
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FEBRUARY, 1922

SUBTEMPORAL DECOMPRESSION

THE operation—subtemporal decompression—is not infrequently misapplied. It is unfortunate, perhaps, that its performance may be unattended with technical difficulties and seemingly does not presuppose, in all cases (for there are notable exceptions), experience and training in neurosurgical problems. It is unfortunate in that because of its apparent simplicity and freedom from complications a subtemporal decompression is performed by the general surgeon in instances where with further investigation and a more intensive study, the lesion might be localized and an exploratory craniotomy warranted—an operation, which the general surgeon may not feel qualified to undertake.

Secondly, the effects of decompression upon the disturbed relations within the cranium are not understood. Accompanying tumors of the brain in the majority of instances, there is an internal hydrocephalus often more accountable for the pressure phenomena than the tumor itself. Under such circumstances what happens when a subtemporal opening is established is this: the ventricle, already dilated, increases in size as it herniates before it the brain through the decompression opening. Thus all the additional space presumably available for a growing tumor is almost immediately usurped by the distended ventricle.

Thirdly, and in consequence of this, the effects of a subtemporal decompression are more restricted both as to the period and as to the degree of relief than we were once wont to believe. Just as the general surgeon has had to modify his conception of the possibility of a gastro-enterostomy in inoperable carcinoma of the stomach, so the neurological surgeon has come to recognize the limitations of the palliative decompression in inoperable tumors of the brain.

We have come to look upon subtemporal decompression as having its larger field of usefulness *not* in the late stages of inoperable tumors, but rather in the initial stages of lesions the nature and precise location of which may be still obscure. Further observation or later developments may reveal the location of the growth, but in the meantime the distressing subjective effects of intracranial pressure may be relieved and vision conserved.

Briefly the indication for a subtemporal decompression in the order of their importance are these:

First, as a therapeutic measure in the treatment of intracranial trauma, especially cerebral contusions with or without basal fractures; it should not be practiced in the cases inevitably fatal within the first twelve hours and the very mild cases.

Second, as a curative measure in a group of cases closely simulating tumors, but later

proving by their eventual recovery to be a circumscribed or diffuse arachnitis.

Third, as a temporary expedient in presumptive tumors, at the moment unlocalizable, for the purpose of relieving headache and conserving vision.

Fourth, in cases of tumor, recognized as inoperable, realizing the limitation of operation both as to the period and degree of relief.

As to the operation itself, the various steps are generally understood. But when the intracranial pressure is extreme the operator should be cautioned against the possible damage to the brain tissue when the dura is opened by the crucial incision usually prescribed. As a substitute for the crucial incision and as a protective measure, we recommend three or four parallel dural incisions a centimeter apart. This modification prevents the sudden protrusion of the brain through a larger opening and the laceration of brain tissue as the brain is forcibly protruded against the edges of the dural opening. If one can visualize the relationship of the ventricle to the seat of operation, the tension may be relieved by a ventricular puncture. When the fluid escapes the tension is in large measure relieved and the dura may then be opened by the crucial incision without risk of damage to the brain tissue.

CHARLES H. FRAZIER.

THE VALUE OF WATER

IN acute surgery, water is perhaps our most potent therapeutic agent, for water has a greater specific heat than any other substance; water has the greatest solvent power; water has the greatest power as a catalyst; water is the only medium in which colloidal systems can be established; water itself is a great chemical activator.

It follows that water is a primary essential to the organism.

The well-being of the organism as a whole depends upon the state of its constituent cells; the state of the constituent cells depends upon the maintenance of their respiration; the maintenance of the internal respiration of the cells depends upon the preservation of the acid-alkali balance and the resultant difference in potential between the nucleus and the cell-body, and upon the degree of permeability of the selective semi-permeable membranes of the cells. The maintenance of the essential properties of the cells—the preservation of their internal respiration—demands a medium with the qualities listed above, that is, water—fresh water.

We are prone to forget that man is a multiple descendant of his ancestral water-born unicellular marine organism; that man has emerged through evolution from the sea, bearing the formula of the sea, and that some parts of his body are almost as liquid as the sea; that he is a landed marine animal, obeying the laws of the sea.

Water, therefore, is the vehicle in which the mechanism of man is suspended, and without fresh water it cannot exist.

It follows that a patient should have water at every stage of his progress. He should have it early before the progress of the disease, or the trauma of operation may have disturbed the internal respiration of the cells. To assure the efficient watering of the cells, water should be given by each and every route that will assure its reaching the cells—by mouth, by rectum, by hypodermoclysis; in sufficient quantities, 2,000, 3,000, 4,000 cubic centimeters, each 24 hours, and continued day after day until recovery or death.

If the patient cannot receive water, if his tissues fail to absorb and use water, it does not mean that *water* has failed; it is a sign rather that the organism has failed, and that irrevocable dissolution is in progress.

Water early; water continuously; water late; water—fresh water always—is a fundamental requirement of restoration and of conservation of the mechanism.

GEORGE W. CRILE.

TOO LATE AND TOO EARLY

ACUTE septic peritonitis still claims many deaths each year, but the deaths usually are attributed to the cause of the peritonitis and not to the peritonitis itself. The statistics of every well-organized clinic show that if the cause of acute peritonitis is removed within 6 or 8 hours, and a proper peritoneal toilet is made to cleanse the contaminated field, the resulting peritonitis will be slight and localized. After 12 hours the prospects of a favorable termination following the removal of the primary cause are greatly reduced; after from 24 to 36 hours such removal may do little to check the spread of the peritonitis, and the operation may greatly embarrass reparative processes and lead to a fatal issue.

It is an axiom in surgery that early operation is vital in the treatment of acute perforation of the appendix, gall bladder, duodenum, and stomach, and almost always cures. In this early stage is the surgeon's golden opportunity, not only to save the patient but to cure him. Experience has taught that if after the safe, early period has passed, the patient can be safely carried along for the several days of the intermediate stage, his natural resistance will usually succeed in limiting the peritonitis and localizing the infection. This is the surgeon's silver opportunity to save the patient, by evacuating septic products although unfavorable conditions may prevent curative procedures.

Much harm has resulted from the failure to recognize the difference between the stage of contamination which is the immediate result of perforation and can be successfully combated by early operation, and a spreading peritonitis resulting from the infection. The cause of the peritonitis is no longer the chief concern but rather the peritonitis itself. The results of plunging into the abdomen too late adequately to cope with the cause of the peritonitis and too early to aid nature's attempt to repair have too often resembled the proverbial "green Christmas" in fattening the graveyard. Ochsner, in practicing his starvation treatment of acute appendicitis and its results, first recognized the danger of operation in the stage between the safe early and the safe late stages of septic peritonitis related to appendicitis. For ten years following the appearance of his articles, there was scarcely a meeting of a medical society in which violent controversy did not arise on the subject. The radicals, although usually wrong, left the field of polemics apparent victors in the controversy by reason of their dramatic portrayal of the disastrous results of *appendicitis*, emphatically proclaiming that appendectomy at any stage was the one and only treatment regardless of pathological conditions in the peritoneal cavity. This pronouncement is, of course, true if the peritonitis is localized to the immediate vicinity of the appendix.

Clinical experience has crystalized our knowledge of septic peritonitis. We now see clearly that intestinal peristalsis is the chief factor in the spread of the infection. Stopping food intake checks the peristalsis much more successfully than the opium treatment advocated by Alonzo Clark in the middle of the last century; although sufficient opium to relieve pain and produce rest is beneficial. The introduction into the body every 24 hours, of a large amount of fluid, from 2000 to 3000 cubic centimeters,

aids in washing out toxic products which may have gained entrance into the blood, and also aids greatly in maintaining the body resistance. If well-borne, proctoclysis is a good method of introducing fluid. For this purpose a solution made with one dram of bicarbonate of soda and two ounces of glucose to one quart of water is preferred. In many instances fluid by rectum tends to produce a certain amount of intestinal peristalsis and gas. In such cases the subcutaneous administration of a normal salt solution containing 3 per cent of glucose has been found to be very satisfactory.

In the early stage of the peritonitis, when it has not progressed far beyond the immediate vicinity of its point of origin, the use of the ice bag is advisable, but in those cases in which large areas of the peritoneum are involved large hot packs applied to the whole abdomen and changed often, not only give comfort, but stimulate circulation in the abdomen. It has been the custom in the Clinic to follow the practise of the late W. W. Mayo of rubbing a dram of mercurial ointment into the skin of the abdomen once or twice during the several days that the hot packs are being applied.

C. H. Mayo has truthfully remarked that a stomach tube gracing the neck of the surgical house officer is more useful than the stethoscope, which is usually to be found there. Forty years ago, Kaussmaul cured patients suffering from septic peritonitis by using the tube to keep the stomach free from fluid and gas regurgitated into it by the antiperistaltic waves of the small intestines. In some cases, tubing the stomach has much the effect of a high enterostomy. It is harmful to irrigate the stomach to the point of tiring the patient; only enough water should be used to start syphonage, and the process should be repeated as often as necessary to keep the stomach empty. Tubage stops the hiccough, and relieves the heart and lungs embarrassed by pressure on the diaphragm by the distended stomach.

When localization is effected the abdominal distention disappears, the vomiting stops and flatus is expelled; then an operation may be considered to have met a definite indication. It is true that death sometimes occurs while the foregoing course of treatment is being followed, especially in neglected cases. Very often the clinician urges the surgeon to operate at an unfortunate time, perhaps subconsciously influenced by his own failure to advise early operation.

All this does not mean that operation is never to be performed in the intermediate stages. Each case must be judged on its merits. The dictum of Murphy holds good, that if the surgeon does operate in the intermediate stage, he must "get in quick and out quicker," under local anæsthesia if advisable, and with least possible disturbance to patient.

Moral: Surgeons will and operators should beware of operating in the intermediate stage of acute, septic, spreading peritonitis.

W. J. Mayo.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

Regular Meeting Held May 20, 1921, Dr. Arthur H. Curtis, Presiding.

KNIFE FOR SECTION OF UTERUS; MODEL DEMONSTRATING LOW CERVICAL INTRAPERITONEAL CÆSAREAN SECTION

Dr. Joseph B. De Lee: I want to take three or four minutes of your time to show an instrument and a plasticene model, demonstrating two features of the low cervical intraperitoneal cæsarean section. I do not intend that these two subjects shall precipitate a discussion upon the general value or lack of value of the abdominal, intraperitoneal, low cervical cæsarean section, although I would welcome such a discussion. What I wish to put on record is the instrument, and second, an improvement in the technique.

This is a modified tonsil knife and it is used for the section of the uterus. After the lower uterine segment is exposed and the incision is to be made into the uterus, I have found that blood interferes with the vision so that in a number of cases the incision has had to be made under the guidance of the fingers. When one is cutting down near the base of the bladder it is important, in addition to having the sense of touch, to have the sense of sight. The operation is simple. The intended upper end of the incision is held with volsellum or with Allis forceps, and the lower end is also delimited by an Allis forceps. The knife is put through the upper end of the cervix as in a tonsil case and slid along on top of the membranes to the lower end of the incision. The knob is forced through the soft muscle, and with a gentle up and down sliding motion it is pulled back and the uterus is opened without any difficulty. The length of the shank is a centimeter more than is necessary for the length of the uterine incision to deliver a 7½ pound baby. If the baby is larger the incision is made a centimeter longer.

The other thing I wish to show you is a plasticene model, showing an improvement of the low cervical cæsarean section, which I invented myself. The model shows the exposed lower uterine segment through which the head bulges. The peritoneum has been split transversely; the upper flap is pulled up with a small retractor not shown in the sketch, and the lower flap has been pulled down by the retractor. That exposes a white surface which represents the fascia over the uterus. I have made dissections of the fascia over the uterus, and I find underneath the peritoneum over the lower half of the uterus there is fascia which is as thick as that shown in the model. This fascia goes to a variable degree upward on the uterus. I have found it possible to incise this fascia and lift it up, as you see here, and put it to the side, and make the incision in the uterus underneath the fascia, and, after the child is delivered, replace the fascia and sew it over, so that the incision in the lower uterine segment does not lie in the same line as in the fascia, but lies in the median line, whereas the fascial suture is off to the side. You may even overlap the fascia and get the Bassini hernia plastic effect.

The advantages of this little addition to the low cervical cæsarean are, first, that it prevents seepage and guarantees against primary infection; second, that it makes the lower uterine segment still more invulnerable against subsequent rupture in following pregnancies. As I have said, this fascia comes up on the uterus to a variable degree. I have not done enough sections to determine how far it goes. Those who perform the low classical cæsarean operation should make use of the fascia to protect the lower part of the wound.

I find that in the classical cæsarean the peritoneum of the incision of the uterus can be overlapped as in the low cervical operation, if the incision is made low in the fundus. You can thus obtain 50 per cent of the benefits of the low cervical incision for the old classical cæsarean section.

ELECTRICAL BREAST PUMP

Dr. Bertha Van Hoosen exhibited and described an electrical breast pump (see p. 268).

TREATMENT OF THE CERVICAL STUMP

Dr. Theodore J. Doederlein: I had occasion recently to observe two cases in which the remaining cervical stump caused trouble. Both were cases of multiple fibroids of the uterus. One patient was an unmarried woman, while the other was married. Both were 45 years of age, and in both instances the tumors were removed supravaginally. In one case, as the report from the laboratory showed malignancy, I hastened to notify the doctor to return the case for removal of the cervix which at operation was in very good condition. The patient failed to return, but a year later had a recurrence of the disease in the vulva.

The other case was one of multiple fibroids. I operated about 3 years ago, and about 2 weeks ago

I operated again thinking it was cancer; fortunately it was a papillomatous growth of the cervical stump as later microscopical examination revealed.

OVARIAN TUMOR CONTAINING THYROID TISSUE

Dr. Arthur H. Curtis: Some 4 weeks ago I operated on a woman for multiple fibroids of the uterus, about fist-size, with double salpingitis and a left ovary which was about double normal size. On opening the ovary I found there was cyst-like, gelatinous material in the acini. This specimen from the ovary is under the microscope and is thyroid tissue. It is teratomatous in origin.

TREATMENT OF PREGNANCY COMPLICATED BY VALVULAR HEART DISEASE

Dr. N. Sproat Heaney read a paper on the heart in pregnancy (see p. 272).

DISCUSSION

Dr. W. George Lee: I have been very much interested in hearing Dr. Heaney's conclusions, because those of us perhaps who are seeing cases apart from gynecological services find that his conclusions agree rather sharply with ours. I take it, that none of us likes to leave until term, patients with heart disease, where there are the marked symptoms of decompensation. However, as Dr. Heaney says, we find that many of these cases showing marked symptoms go through labor surprisingly well and promptly improve.

It seems to me, that one phase he did not mention might well be noted—that is the presence of heart trouble with kidney trouble, or rather where the heart trouble is secondary to an underlying nephritic factor. These are the cases that show a very grave prognostic danger largely because of the fact that the heart has little reserve with which to combat the higher blood pressure that ensues during the stress of labor, with deficient elimination that increases the toxæmia.

I am very glad to see that Dr. Heaney advocates strongly the conservative treatment of these conditions, because I think very often the so-called conservative treatment is really most effective, and the net result justifies it.

Dr. Joseph L. Baer: Our friends, the internists, have recently begun to pay more attention to the question of interpreting heart disease in connection with pregnancy. I think it is becoming more possible to evaluate the heart capacity than it has been in past years because of the advances made in the special study of the heart, so that in the future we will have a more hopeful outlook on the prophylaxis of heart disease in pregnancy, on which point Dr. Heaney touched but felt unable to reach a conclusion. Without special heart training, we are not in a position to say that a symptomless heart lesion is one that shall not permit the woman to go into the pregnant state.

The two things that are developing in the special study of heart disease are, first, the electrocardiograph, which unquestionably is becoming an instrument of precision and is enabling the experts in its uses to tell us something of the intrinsic capacity of the heart muscle in a particular case, and when they shall have reached their conclusion we will be able to utilize that information. Another instrument that has recently made its appearance was called attention to by my colleague, Dr. Hamburger, namely, Peabody's spirometer, which is nothing more nor less than a receptacle which can be inflated over water by blowing into it; the cardiac suspect is requested to blow into this water-tight chamber and his pulmonary capacity is the measure of his cardiac reserve. The men in the East who have done the early work with it are finding they can determine a beginning heart breakdown long before the patient has subjective symptoms; in other words, before there is any evidence which would lead us to suspect that a heart with a "blow" is going to be a heart with symptoms after a little while. These two devices will probably make a difference in the decision whether or not a woman shall be permitted to become pregnant.

According to the literature and our experience, it is the case with the rather severely injured heart which dies immediately following the second stage. The explanation of a sudden death immediately after delivery, regardless of the type of delivery, has never been sharply defined, but death would seem to be due to a sudden removal of the uterine contents, the sudden overflowing of the splanchnic vessels and a resultant right heart collapse. For many years in the Michael Reese clinic we have used a simple device which is probably familiar to most of you. A sandbag is in readiness, and when the uterus is emptying, the fœtus progressing through the birth canal, the sandbag is applied across the waist over the upper abdomen to maintain intra-abdominal pressure and prevent the sudden engorgement of the splanchnic vessels. I am not in a position to say that it is or is not efficacious.

Dr. Joseph B. De Lee: I am getting to be more afraid of heart cases now than I ever was, for the reason that we cannot at present determine how a given heart is going to act in a given labor.

Dr. Heaney in his paper probably did not intend to differentiate between the different kinds of heart disease and their varying prognoses. That would be a very difficult thing to do and has not been done satisfactorily up to now. The general opinion, however, is that the mitral stenosis cases are those with the worst prognosis, and my own experience, of course not large in comparison with the general experience, is confirmatory of this general dictum. The myocarditis cases and cases of myocardial degeneration combined with any one of the other heart lesions make a doubly bad prognosis. I am, therefore, inclined to pursue a more active line of treatment than was recommended by the author of the paper.

We have had at the Chicago Lying-In Hospital within 2 years three sudden deaths from heart disease, and they were all cared for by good men, who carried out the standard principles of treatment as were laid down by Dr. Heaney. The sandbag after delivery was not always used but the hand was kept on the abdomen and a certain degree of counter pressure was made. The use of the sandbag was taught by Dr. Jaggard 30 years ago. A tight binder is put on the woman afterward with the same object in view.

What I would like to insist upon in these general remarks is the necessity of associating an internist with the obstetrician in all cases of heart disease. No one of us can be perfect even in a small part of any specialty, and therefore to be sure that our patients get all the advantages of our art we should call in a heart specialist, and thus guard against fatal accidents. I know that we can carry women very safely through labor (with the aid of the heart specialist) even though they may die afterward, and in larger numbers than the ordinary run of heart cases. I myself within 18 months have lost two women who were successfully carried through labor. One died a week after the baby was born, and autopsy showed a simple myocarditis. Another was carried along until the child was viable and delivered safely by section. She went home and died in a month. We were convinced the woman's life was shortened by being carried through her pregnancy. I have come to adopt this rule in the treatment of heart disease, complicating pregnancy; if it is a case of myocarditis and the woman is a primipara, a very careful consideration of the case is made and the possibility of emptying the uterus and sterilizing her at the same time is considered, and usually favorably considered. If it is a case of mitral stenosis, we put the woman to bed a large portion of the time, giving her enough exercise to keep up nutrition, and as soon as the child is viable, we do cæsarean section under local anæsthesia. To obviate the nervous strain which Dr. Heaney mentions we begin to educate the woman as soon as she is at the hospital about the beauties of local anæsthesia, and while I cannot say we have been uniformly successful, we have been very much more successful than we had reason to believe we would be. A great deal depends upon the temperament of the patient. We do a very low classical cæsarean. We do not supplement with gas but give ether. I am not convinced that gas is less dangerous than ether. We have the woman digitalized at the time. As soon as the baby is born she gets a hypodermic of morphine, one-third grain with scopolamine 1/200. I know that women have been given morphine and scopolamine before the baby is born, but I still have the fear that morphine affects the baby adversely. Dr. Falls did a cæsarean section in a heart case with success under morphine, scopolamine, and novocaine. Newell, of Boston, does cæsarean section under local anæsthesia, and if we can give these women morphine we have obviated the danger of fear the doctor called attention to. We sterilize all women who have marked mitral stenosis. If a woman has marked mitral regurgitation, we usually let her go to term or let her go into labor, but as soon as the cervix is dilated we do not allow her to deliver the baby. Our rule is to do episiotomy and deliver with forceps. With the above mentioned exceptions it is our rule in heart cases to deliver from below, and they get large doses of morphine and scopolamine and bromides during the first stage of labor.

I cannot say that the cæsarean cases we have had are so much annoyed with tympany and vomiting as one might infer from Dr. Heaney's paper. I will in the future pay more attention to that particular point. Since the meeting I have had 6 low cæsarean sections. Only 1 woman vomited and only one emesis, 24 hours after operation. No one had distressing tympany.

The subsequent care after the delivery is also one of great importance, and it is necessary to have the interne and nurse with all means of resuscitation ready in these heart cases for 6 hours after delivery. I have delivered women without any trouble whatever, with no danger threatened, and yet in 2 or 3 minutes or hours they would pass away.

Dr. Charles S. Bacon: The question of determining during pregnancy the condition of the heart and the progress of the trouble in the heart is of the very greatest importance, and in addition to the means suggested, of calling in consultation a heart specialist, I think we can all profit by systematically testing out the heart.

There is one thing I would like to ask Dr. Heaney. He speaks of the method of inducing labor by separating the membranes. If a patient has a dilatable cervix, it is possible to separate the membranes for a short distance, and undoubtedly that frequently helps, but in case of a primipara with a long cervix, how is he going to proceed? In regard to the method of inducing labor, I think it is perhaps better to introduce a large bougie similar to a rectal bougie into the uterus, something that is big enough to accomplish more than can be accomplished with the small bougies formerly used.

There is one class of cases that should be borne in mind, namely, those cases of myocarditis which develop in the toxæmia of pregnancy. Such cases may show no valvular lesions at all, perhaps no suspicion of trouble, but occasionally at the time of labor or sometimes after labor, the patient suddenly succumbs or shows serious symptoms, because of a very weakened heart. In all cases of toxæmia that feature is to be considered.

Dr. Carey Culbertson: It is true, as Dr. Baer has stated, that the internist is of invaluable assistance in the management of cases of pregnancy complicated by heart disease. But the test as to what influence pregnancy has upon cardiac disease is not based upon how the patient gets through a certain labor. It is a test as far as that individual labor is concerned, but can we say the heart is as

good after the strain of pregnancy, plus labor, as it was before, or as it would be if pregnancy and labor had not taken place? I believe that pregnancy and labor certainly do not do the heart any good, even one that is compensating. Therefore, the chances are it does some harm. We see too often the woman who brings into the world a few children and who dies at midlife of heart disease. No one can tell whether she would have lived longer if she had not borne children; nevertheless, we have reason to believe that such would be the case.

I have thought for a long time that until we have vital statistics in large numbers, we will not know what the influence of pregnancy on cardiac disease is. If the vital statistician could give us the ages of death of a thousand women with heart disease who had not borne children, and of a thousand women with heart disease who have borne children, we would have some definite information on the subject that would be of value.

The thing I would emphasize is that the way a woman gets through a certain labor is not a test.

A second point which the paper brought up is this: in my gynecological laparotomies I use a great deal of nitrous oxide gas, but I have learned to leave it alone in those cases where the patient has a heart lesion. I do not believe in the use of nitrous oxide gas even in a compensating mitral regurgitation. In stenosis I would never use it. Some of us believe that nitrous oxide gas is the preferred analgesic or anæsthetic in labor; we should not go on using it routinely where the labor is complicated by some cardiac lesion merely because our case is an obstetrical one.

Dr. William C. Danforth: The devices that have been mentioned, the electrocardiograph and spirometer, may help us very materially and if they do, we will have made an important step forward in handling cases of pregnancy complicated with heart disease. For the present we have nothing other than physical examination. Two cases I have seen quite recently will illustrate our difficulties in prognosis. One young woman, who had mitral stenosis, was the worst of the two. She had gotten through one pregnancy before, and in her second pregnancy she was in bad condition, having evidence of not only decompensation but attacks of paroxysmal tachycardia lasting 3 or 4 hours, with a pulse of 160. A competent internist was called in consultation who said she might go through her labor without danger. She did so and is perfectly well. Her heart lesion remains, of course, as it was.

A second woman, who was apparently perfectly well, gave no history of cardiac trouble and showed none. At the end of 8 hours of normal labor, forceps were applied to the head on the perineum. Before anæsthesia was complete she ceased breathing and died in about 4 minutes. Autopsy showed no cause for the death other than a myocarditis and adhesive pericarditis.

As to the delivery of these cases, I agree with the essayist. I think delivery by induced labor should be undertaken a little early, as a rule, and believe this is the easiest way out.

I have had the same experience with classical cæsarean section as the eassayist has, that is, my patients got tympanites and vomited for 2 or 3 days after delivery. This is a great strain on them, and I believe in the first stage of labor and in a part of the second stage the use of morphine will enable these women to go through with the least strain on the decompensated heart, and this is better than a laparotomy.

I have not had good luck with local anæsthesia. I have given it up and have used inhalation anæsthesia and find that the mental and nervous strain of the patient is not so great as it is under local anæsthesia. If we could use morphine and scopolamine beforehand I think it would help a great deal.

Dr. Heaney (closing): I decided to write this paper on heart lesions because I recently had a doctor's wife under my care with a severe heart complication in pregnancy. Her heart had always been compensated in spite of the fact that she had always been an athlete and indulged in the most violent sports. During the early part of her pregnancy she had no difficulty. About mid-term she, however, began rapidly to enlarge, and twins with hydramnios were diagnosed. She then began to have heart symptoms, a blood-pressure of 170 to 180 soon became manifest, when the heart became very seriously embarrassed. She went into spontaneous labor and had a rapid delivery of nonviable twins but made a good convalescence. In this case twins alone would have been enough to tax her heart, but, added to it, hydramnios and then finally the high blood-pressure, the case became a serious one when under ordinary conditions it might have been possible for her to go to term without much difficulty.

I notice that universally mitral stenosis is pronounced of graver prognosis than other heart lesions. I am inclined to doubt this statement and believe that it is a remnant carried down from the older literature. The condition of the heart muscle, of course, is the really important factor. In one case the heart muscle may be better in mitral stenosis, while it is poor in another heart lesion.

When Dr. De Lee arose, I wondered which one of his operations he was going to propose for the woman with a bad heart. At first I thought he was going to recommend low cervical cæsarean section alone but he recovered himself and also recommends prophylactic forceps with episiotomy. To the second recommendation I do not take exception except if the operation produces more pain after delivery than would be present in the event that the woman had an easy spontaneous labor.

Any type of cæsarean section, whether low or high, cannot be regarded as a surcease from troubles, since the convalescence is painful, the patient has sleepless nights and, while a certain amount of strain is saved the patient in labor, she more than

pays for it by the difficulties encountered in her postoperative recovery.

My most serious objection to the prophylactic forceps is the name; I think that in general we are inclined to credit ourselves with avoiding more things than we actually accomplish. If in doing a prophylactic forceps we lose a baby which might have been saved by more conservative procedure, what do we care if we have saved the woman a possible cystocele 15 or 20 years hence?

I believe that in no class of cases do we have to proceed more cautiously in selecting the method of treatment than in obstetrical cases complicated by heart lesions. Ordinarily I prefer to induce labor by giving castor oil and quinine after separating the membrane widely with the examining finger.

Dr. De Lee: How often does it work?

Dr. Heaney: It works often enough to try it. By that I mean that ordinarily there is no hurry about the induction of labor when broken compensation is present so that if not successful the patient is not harmed but on the contrary the catharsis is ordinarily good for a patient with broken compensation. If not successful, it may be repeated at another time or, if the case becomes more urgent, some other method of induction tried.

Dr. De Lee: Castor oil works less often than it does work.

Dr. Heaney: In women at term induction of labor with castor oil is easily accomplished. In premature labor it frequently is not successful. In a woman with broken compensation, however, we have different conditions than in a normal woman. Then, ordinarily, the cervix is soft and œdematous and is easily dilated and the induction of labor is much more easily accomplished, under such conditions. When the cervix is long and the index finger cannot be introduced, the induction of labor is not so easy.

In closing, I would say that I believe that experience does not justify the standpoint that because a woman has a demonstrable heart lesion pregnancy should be denied her.

Dr. William A. Peterson read a paper (by invitation) on "Ferments Generated during Pregnancy and Their Effects on Tuberculosis."

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

Éléments d'Obstétrique. By Dr. V. Wallich. 4th ed. Paris: Masson et Cie, 1921.

Diagnostik der Chirurgischen Nierenerkrankungen; Praktisches Handbuch zum Gebrauch fuer Chirurgen und Urologen, Aerzte und Studierende. By Professor Dr. Wilhelm Baetzner. Berlin: Julius Springer, 1921.

Some Medical Ethical Problems Solved. By Reverend M. P. Bourke, A.M., LL.B. Milwaukee, Wisconsin: The Bruce Publishing Co., 1921.

The Practical Medicine Series. Edited by Charles L. Mix, A.M., M.D., vol. v—Gynecology, edited by Emilius C. Dudley, A.M., M.D., LL.D.; Obstetrics, edited by Joseph B. DeLee, A.M., M.D. Chicago: The Year Book Publishing Co., 1921.

The Heart Rhythms. By Paul Dudley Lamson, M.D. Baltimore: Williams and Wilkins Company, 1921.

Medical and Surgical Reports of the Episcopal Hospital, vol. v. Philadelphia: William J. Dornan, 1920.

Submucous Resection of Nasal Septum. By W. Meddaugh Dunning, M.D. New York: Surgery Publishing Co., 1921.

The Surgery of the Peripheral Nerve Injuries of Warfare. By Harry Platt, M.S. (Lond.), F.R.C.S. (Eng.). New York: William Wood & Co., 1922.

BOOK REVIEWS

CRITIQUE OF NEW BOOKS IN GYNECOLOGY AND OBSTETRICS

By GEORGE GELLHORN, M.D., F.A.C.S., St. Louis, Missouri

SOMEWHERE in his *Outline of History*, Mr. H. G. Wells questions the popular assumption that there is some innate intellectual drive in the West and some innate indolence and conservatism in the East that assure the white man a world predominance forever. People do not realize that in Asia the average brain is not one whit inferior in quality to the average European brain. It has always been difficult to restrain the leakage of knowledge from one population to another; and now it becomes impossible. Under modern conditions world-wide economic and educational equalization is in the long run inevitable. An intellectual and moral rally of the Asiatics is going on at the present time. The slight leeway of a century or so, a few decades will recover.

I was reminded of this passage when the new book by Kedarnath Das[1] reached me. This book is a condensed and abbreviated edition of the same author's *Handbook of Obstetrics* which was reviewed in these pages some years ago.[2] There is nothing in this work to indicate that it was not written by an American or European scholar. The make-up of the book as well as the arrangement of the text conforms closely with those of our best works. The views expressed and the advice given differ in no wise from accepted standards. A large number of instructive illustrations have been culled from American, English, French, and German books, and in the preface there is not lacking even the customary reference to "the busy practitioner" to whom this book is recommended, for ready reference, as a concise, practical, and up-to-date guide in his practice. Only the title page with its dedication to the use of students in the medical schools and colleges in India denotes the exotic character of the book and confirms once more the truth of the assertion of Mr. Wells. We would do well to relegate Rudyard Kipling's phrase of "the white man's burden" to the realm of jingoistic propaganda.

ELEVEN years after the second edition, Jellett has, with the help of Madill, brought out a new edition of his *Manual of Midwifery*.[3] It is an excellent and very complete work of which one can speak only in words of praise. For us, its chief interest lies in the fact that its author has been "master" of the Rotunda Hospital in Dublin and that it reflects the views, statistics, and experiences of that famous school of obstetrics. To judge from the book before us, the distinguishing feature of that institution is a healthy conservatism—but this conservatism is not the static kind that cherishes only the home product and frowns on all innovations from abroad; rather is it the progressive sort that carefully tests, critically weighs, and then ungrudgingly adopts the good wherever it may come from. Proof of this may be seen in the frequent quotations from foreign literature, particularly from America and Germany, and thus the book offers us in palatable form a synopsis of the world's achievements in the science and art of obstetrics.

There is, however, much that appears to be characteristic of the Rotunda Hospital. There is, for instance, an evaluation of insanity in connection with obstetrics, which seems so much greater than in our own textbooks. Persistent insomnia during pregnancy, while, fortunately, rather rare, must be considered a precursor of insanity. The insanity of lactation which forms from 3 to 4 per cent of all cases of mental disease in females, is essentially the result of malnutrition and exhaustion; sometimes weaning appears to be the immediate cause. Influenza in pregnancy is very apt to produce mental derangement. In all, so the author contends, the process of reproduction is responsible for psychical abnormalities at least once in every three hundred births.

In the therapy of placenta prævia, the Rotunda school is opposed to cæsarean section as a matter of routine and adheres to the Braxton Hicks method. Of 260 mothers thus treated, only 9 died; the fœtal mortality, as is to be expected in this method, is very high—from 40 to 75 per cent. In eclampsia the Rotunda Hospital favors the Stroganoff régime. For forceps extraction the author advocates, as the preferable procedure, the use of an axis-traction instrument. The indications for the use of forceps are rather strict. In 11,098 deliveries at the Rotunda Hospital, forceps were applied only in 431 (3.8 per cent) with no maternal and a fœtal mortality of about 14 per cent. Hyperemesis appears to be rare in Ireland; only 32 instances occurred in 37,930 cases (1 in 1154). Intra-uterine death from all

[1] A Textbook of Midwifery for Medical Schools and Colleges in India. By Kedarnath Das, C.I.E., M.D. Calcutta and Simla: Thacker Spink and Co., 1921.

[2] Surg. Gynec. & Obst., 1915, xx, 499.

[3] A Manual of Midwifery; for Students and Practitioners. By Henry Jellett, B.A., M.D., F.R.C.P.I., L.M., and David G. Madill, B.A., M.B., B.Ch., B.A.O., L.M. 3rd ed. New York: William Wood & Co., 1921.

causes is all too frequent; the author points with alarm to the fact that one out of every 18 pregnancies terminates in abortion or stillbirth. Vaginal douches are inadvisable in pregnancy or labor; in contradistinction, after-pains may be relieved by an intra-uterine douche, if medicinal and other procedures fail to give relief. The Credé method of expression of the placenta seems to have been practiced in the Rotunda Hospital for many years prior to its re-discovery by Credé. In habitual abortion, potassium chlorate has been found empirically to avert the death of the fœtus. The reduction of an inverted uterus can be made less difficult by injection of adrenalin into the inverted organ and the temporary diminution in size following the injection. There are also a few Rotundacisms which are bound to arouse protest in this country, but let the reader discover these for himself.

MEDICAL monographs are a barometer of the intensity of scientific study on the part of the writers and of the scientific interest and receptivity of the reading public. They are highly stimulating because, unhampered by the eternal lack of space in textbooks, the author can present the *entire* material at his disposal and will thus provoke fruitful discussion. They are irksome only to those who demand a short-cut to knowledge and act on impressions and personal preferences rather than on logical conclusions from well-established facts.

Hitschmann's monograph on the therapy of placenta prævia[1] is a case in point. Kroenig and Sellheim, in 1908, advocated cæsarean section as the best treatment of placenta prævia. (It may be added, parenthetically, that A. C. Bernays, of St. Louis, was in fact the first, in 1897, to suggest and perform cæsarean section for this indication.) Hitschmann sets himself the task to prove by a critical analysis of, in all, 6,438 cases of placenta prævia recorded in literature, that the older methods of podalic version and metreurysis yield results equal if not superior to those of cæsarean section in the overwhelming majority of the cases. It is doubtful whether his contentions will meet with undivided acceptance, and the fact that he leaves the life of the child altogether out of consideration, must needs create opposition. But Hitschmann's studies serve to recall our thoughts from the purely surgical view-point, and his statistics and his argumentation will, perhaps, induce those in charge of large maternity services to look over their records. This monograph, therefore, is useful as a basis for discussion in the periodical debates as to the relative merits of the various methods at our disposal.

NOW that the era of the classical cæsarean section is over, says Vogt in his monograph,[2] and a new epoch of abdominal section has begun, it is time to review the history and development of the technique of the intraperitoneal cervical cæsarean section. This, then, is the subject which is dealt with in six chapters. Special emphasis is laid upon the technique as carried out at the University Hospital in Tuebingen, where the author occupies a teaching position. Immediate and late results are discussed in separate chapters. The indications are enumerated and a comparison is made with competing methods, in particular the classical cæsarean section. The advantages of the new method in infected cases are presented at some length. Finally, the author considers the operation in connection with the problem of fœtal mortality—in Germany about 80,000 children die annually at or soon after birth—and he hopes that the cervical cæsarean section will reduce this appalling loss to a considerable extent.

As, in this country, the cervical cæsarean section has not yet found many adherents despite its many good points, the reader will be interested in this publication with its underlying material of 778 cases; and he will find its perusal highly profitable though he will feel that the author, with his decided leaning toward this particular operation, has not always distributed light and shadow impartially upon the question under discussion.

IN France, a series of small monographs is being published which purpose to acquaint the practitioner with the topics of the day in obstetrics and gynecology (*L'Actualité Obstétricale et Gynécologique*). The pamphlet before us[3] deals with the use of pituitary extracts in our special field. After a short introduction comprising the anatomy and physiology of the pituitary gland and the history of its medicinal employment, the greater part of the booklet is devoted to the rôle of pituitary extracts in obstetrics. This chapter is very well written, but it offers nothing new to the specialist who is familiar with the literature. Less widely known and utilized are the advantages of pituitary extracts in certain gynecological affections, such as chronic metritis with copious discharge, dysmenorrhœa in young girls, menorrhagias and metrorrhagias due to ovarian hyperfunction, pruritus vulvæ, etc. The author has also seen good results in chronic infections of the uterus and adnexa and ascribes them to improvement in the pelvic circulation. A long list of bibliographic references shows that the author has studied the literature carefully in the preparation of his monograph. It is gratifying to notice that he does not lose sight of the fact that the pituitary extracts may do harm if used in improper dosage or in violation of the contra-indications which are set forth in detail. In fact, the pamphlet deserves only favorable comment, and we extend to the editor all good wishes for success in bringing out this series of practical monographs.

[1] Die Therapie der Placenta prævia. By Prof. Dr. F. Hitschmann. Berlin: S. Karger, 1921.

[2] Ueber die Entwicklung und den Ausbau der suprasymphysaeren Schnittentbindung an der Universitaets Frauenklinik Tuebingen. By Dr. Emil Vogt. Berlin: S. Karger, 1921.

[3] Les Extraits Hypophysaires en Obstétrique et en Gynécologie. By Dr. Léon Pouliot. Paris: L'Expansion Scientifique Française, 1921.

COMPENDIA or *vade mecums* written in a foreign language can hardly count on a wide popularity among American students. To the specialist and the teacher, however, they are of great interest because they present the author's views, as it were, in a nut shell. This is eminently true of the book before us [1] in which an amazingly large variety of subjects has been condensed within a very small compass, and which reflects the individuality of the author on almost every page. In addition to the subject matter which we would expect to find in a book of this character, we encounter sections dealing with the disturbances of the sexual life, the relations between gynecologic and systemic diseases, the affections of the breasts, the urinary apparatus, and the rectum in so far as they come within the ken of the gynecologist. Of particular interest to us is the chapter on nasal reflex neuroses. Koblanck has long been a strong believer in the theory propounded by Fliess of the connection between the nose and the genital organs, but in its practical application he goes considerably farther than Fliess himself. Whereas the latter had only contended that the cocainization (or electrocaustic destruction) of the "genital spots" in the nose would relieve dysmenorrhœa and the pain of labor, Koblanck claims astonishing results from this treatment in that form of sterility which is caused by spasm of the internal os, in hyperemesis gravidarum, in masturbation, and in mucous colitis; and even in homosexual individuals this nasal treatment may render the accentuated sexual instinct more blunt and thus help to hold the perversion in check. Everywhere in this book there is abundant evidence of the immense practical experience and resourcefulness of the author, and those who proclaim that gynecology is essentially pelvic surgery, may read with some astonishment of the wide variety of remedial agents other than surgical which may be used to advantage in gynecologic ailments.

OF Doederlein's *Guide* for obstetrical operations [2] hardly more need be said than that this popular compendium has recently appeared in its thirteenth edition. The persistent demand for this book sufficiently characterizes its great value for the student and practitioner. Of the various alterations in this edition, one should be noted in particular. Doederlein has changed his attitude toward manual extraction of the after-coming head in breech deliveries and strongly recommends in its stead the application of forceps. Like all the writings of Doederlein, the diction is very simple and clear. This and the many instructive diagrammatic illustrations make it easy even for those who do not read German fluently, to follow the text and to profit by the advice and experience of a renowned teacher.

A BOOK that arouses at once admiration and criticism, is Berkeley's *Handbook of Midwifery for Midwives, Maternity Nurses and Obstetric Dressers.* [3] One is amazed at the versatility of this prolific author whose works have repeatedly been reviewed in these columns. Both the make-up and the plan of the book deserve the highest praise. It is of small enough size to be carried in the satchel, and in its 550 pages the midwife or nurse will find information on every subject connected directly or indirectly with the art and science of obstetrics. For every condition encountered there is a complete and very lucid description of the cause, the symptoms and the signs, there are clear-cut instructions as to the points to be looked for and the steps to be taken, and there is finally the direction when to send for the physician; to this is appended in every case an outline of the treatment the doctor is likely to give so that the nurse may duly prepare the patient and the surroundings. There are also chapters on the anatomy and physiology of mother and child, on bacterial infection and immunity, asepsis and antisepsis in obstetric practice, on principles of domestic and personal hygiene, on action of drugs, etc.

As may be seen from this all too brief characterization, the book is really a most complete treatise on obstetrics, and the question is merely this whether a midwife who, in England, is required to pass through a training of only 6 months, can ever assimilate this splendid array of facts. Then, too, the constant use of technical and other learned terms (pericranium, *sine qua non*, autogenous vaccines etc.) threatens to be far above the head of the rank and file. Here and there one feels inclined to dispute the specific instruction issued. In premature separation of the placenta, for instance, the midwife is told to rupture the membranes and administer a drachm of ergot before the doctor arrives; and in uterine inertia, the finger is to be inserted through the external os and made to sweep round between the membranes and the lower uterine segment.

Nothing in these remarks should be misconstrued as an attempt to discredit the book. On the contrary, its study has proved highly stimulating; and after all, conditions in Great Britain differ from ours, and the high estimation in which this book is held by the nursing profession "over there" is shown by the fact that this handbook has had five editions and three additional reprintings in the course of fourteen years.

[1] Taschenbuch der Frauenheilkunde. By Prof. Dr. Koblanck. 2nd ed. Berlin and Vienna: Urban & Schwarzenberg, 1920.

[2] Leitfaden fuer den geburtshilflichen Operationskurs. By Dr. med. et Dr. art. obs. h. c. Albert Doederlein. Leipzig: Georg Thieme, 1921.

[3] A Handbook of Midwifery for Midwives, Maternity Nurses and Obstetric Dressers. By Comyns Berkeley, M.A., M.C., M.D. F.R.C.P. (Lond.), M.R.C.S. (Eng.). 5th ed. London, New York, Toronto and Melbourne: Cassell & Co. 1920.

AMERICAN COLLEGE OF SURGEONS

GROUP MEETINGS OF STATE AND PROVINCIAL SECTIONS OF THE CLINICAL CONGRESS OF THE AMERICAN COLLEGE OF SURGEONS FOR 1922

AT a meeting of the Executive Committees of all states and provinces held during the Clinical Congress in Philadelphia, it was determined to unite the states and provinces in small sectional groups for the purpose of holding joint meetings during 1922.

After a year of uniformly successful, individual state and provincial clinical meetings, changes in their organization are considered advisable for two reasons: First, to arrange for a larger attendance than the Fellowship of the smaller states could provide; and, second, to obviate the burden of time and expense incident to holding an annual meeting in each state and province.

This group arrangement will insure larger and better meetings; it will attract as speakers the very best scientific talent in this country; it will relieve the various Executive Committees of the burden of arranging a meeting each year; and it will give the Fellows an opportunity to see the clinical work of their confrères in neighboring states and provinces.

The sectional grouping will in no way impair the individuality of the existing Executive Committees and Committees on Credentials. It is simply a union of states and provinces for better and larger meetings.

The following groupings were adopted at the Philadelphia meeting:

Wisconsin, Minnesota, North Dakota, Montana.
Nebraska, Iowa, South Dakota.
Missouri, Kansas.
California, Arizona, Nevada.
Texas, New Mexico, Oklahoma.
Alabama, Mississippi, Louisiana, Florida, Georgia.
Kentucky, Tennessee, Arkansas.
North Carolina, South Carolina.
Virginia, Washington (D. C.), Maryland, West Virginia.
Pennsylvania, Delaware, New Jersey.
New York.
Ontario.
Quebec.
New England States.
Nova Scotia, New Brunswick, Newfoundland, Prince Edward Island.
Manitoba.
Saskatchewan, Alberta.
British Columbia, Washington, Oregon, Idaho.
Utah, Wyoming, Colorado.
Ohio, Michigan.
Illinois, Indiana.

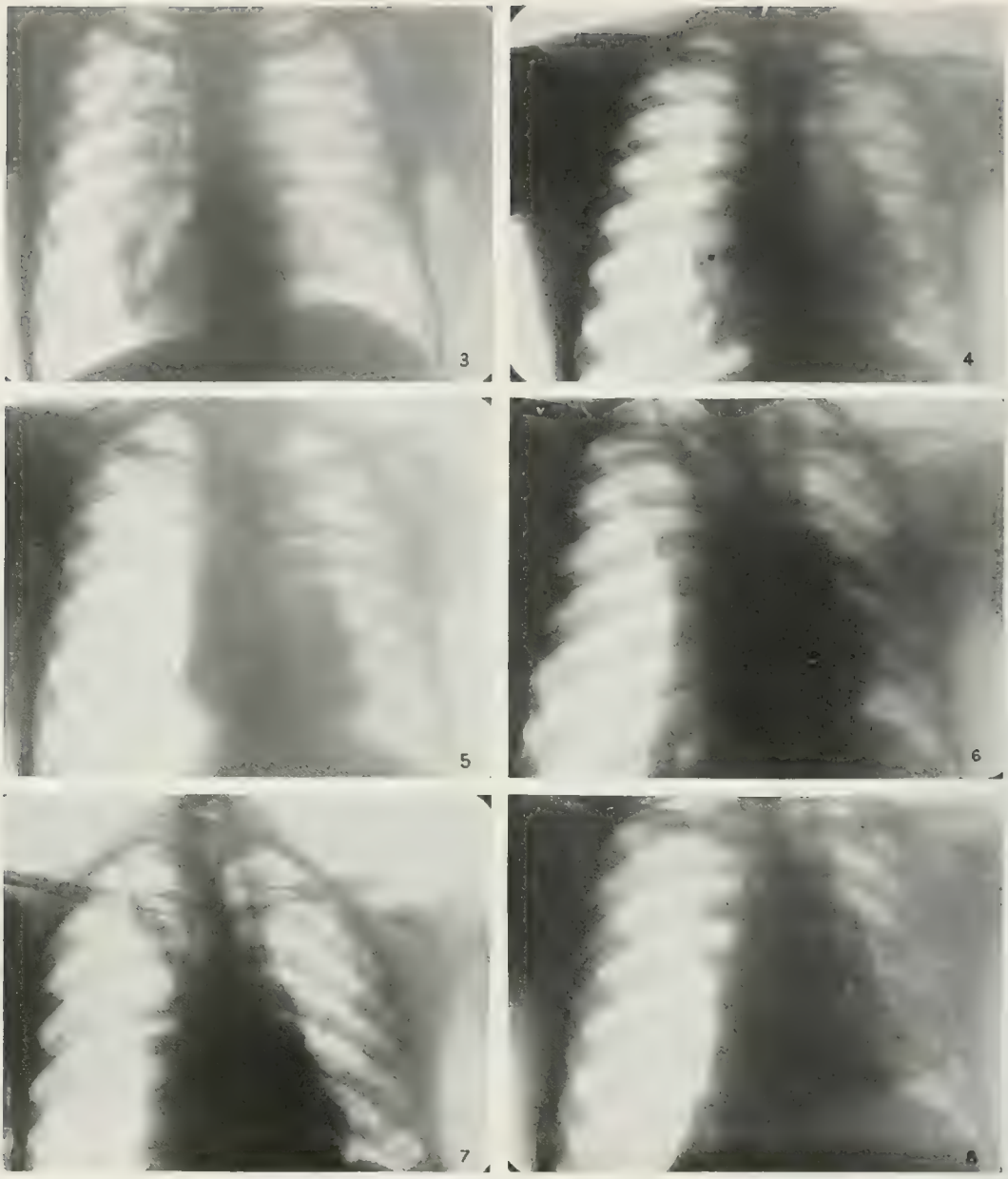

Fig. 3. The most common form of adhesions before burning.
Fig. 4. Same case after first burning.
Fig. 5. Same case after removing of all adhesions. Case of Herman Erickson.
Fig. 6. Adhesions to the upper part of the pleural cavity before burning.
Fig. 7. Same case after burning of one adhesion.
Fig. 8. Same case after burning of all adhesions. Case of Bergman.

The Practical Importance of Thoracoscopy in Surgery of the Chest. — H. C. Jacobaeus.

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THE PRACTICAL IMPORTANCE OF THORACOSCOPY IN SURGERY OF THE CHEST[1]

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FOR the last 10 years I have been using the endoscope in studying the peritoneal and pleural cavities. At first I was interested only in the diagnostic advantages that could be gained with such a method. For instance in cases with ascites, after tapping and replacing the ascitic fluid with air, I could obtain by means of the endoscope a clear and comprehensive picture of the abdominal organs. It was thus easy to study the different conditions of the liver and to diagnose cirrhosis, benign tumor, malignant tumor, Pick's disease, syphilis, etc.; in cases of carcinoma and tuberculosis of the peritoneum, the endoscope revealed the characteristic changes. At first I used endoscopy and laparoscopy only on patients with ascites, but I have recently used it to a great extent in examining patients without ascites, thus considerably increasing its field of usefulness. I have further combined laparoscopy with simultaneous X-ray examination of the abdominal organs, while the air is still in the abdominal cavity, following the methods of Long, Weber, and others. These methods complement each other and are especially successful in studying the diseases of the liver and the spleen and the formations of adhesions in the abdominal cavity. The method has not been in use long enough as yet to enable us to form definite opinions regarding its practical value.

Without doubt, however, the most interesting use of the endoscope is for the examination of the pleural cavity—so-called thoracoscopy. For, as we know, we have nothing for examining the chest cavity which corresponds to the exploratory laparotomy for examining the abdominal cavity. Furthermore, thoracoscopy is such a simple method that it can be performed without inconvenience in every case of exudative pleurisy in which thoracocentesis can be done. The ocular examination of the pleural surfaces can in most cases be made relatively complete. In most cases of so-called idiopathic pleurisy I have also succeeded in finding distinct tuberculous nodules. In making a differential diagnosis between tumors and pleurisy of other origin, thoracoscopy is of no small value. After some practice it is possible to differentiate with some certainty between tumor metastases and tuberculous changes. In doubtful cases one can, by excising under guidance of the thoracoscope, determine the nature of the pleurisy in a special case. Even solid intrathoracic tumors can be observed with the thoracoscope, and their relations to neighboring organs—the lung, the thorax wall, etc.—can be determined much more clearly than by any other method.

From a practical point of view the most important field for the application of this

[1] Presented before the Clinical Congress of American College of Surgeons, Philadelphia, October 24-28, 1921.

method is no doubt in operations which can be performed directly under the guidance of the thoracoscope. While working with the thoracoscope in cases of pulmonary tuberculosis subjected to the pneumothorax treatment, I have noticed that a specially clear picture is obtained of existing string-like or membrane-like adhesions between the lung and the thoracic wall. This led me to try to work out a method of removing such adhesions under the guidance of the thoracoscope. It is a well-known fact that a single string-shaped adhesion attaching the lung to the thoracic wall may prevent a cavity from collapsing, thus causing the entire pneumothorax treatment to be a failure. A paper recently published by Gravesen from Professor Saugmann's sanatorium contains the following table which shows the injurious effects of adhesions.

TABLE I.—STATISTICS FROM SAUGMANN'S CLINIC

1. Cases with complete pneumothorax without adhesions, 3 to 13 years after being discharged

	Case	Percentage
Able to work	23	70.2
Not able to work from tuberculosis	1	2.1
Died from tuberculosis	11	23.4
Died from other causes	1	2.1
Unknown	1	2.1

2. Cases with complete pneumothorax but with localized, extended adhesions

	Cases	Percentage
Able to work	14	33.33
Died from tuberculosis	28	66.67

3. Cases with incomplete pneumothorax with larger or smaller extended adhesions

	Cases	Percentage
Able to work	5	11.1
Died from tuberculosis	39	86.7
Died from other causes	1	2.2

The injurious effect of the adhesions is simply demonstrated by this table. It also gives one an idea of their frequency. I will not mention here the different methods attempted by others to remove such adhesions; I will only say that none of them has proved to be any more practical than my method.

As it was rather easy to observe the adhesions through the thoracoscope, the thought occurred to me that it would be a simple matter to cauterize the adhesions by introducing a galvanocautery into the chest under the guidance of the thoracoscope. The first attempts to do this were made in 1913, and since then I have used this method in 55 cases. I will give briefly below the results in 50 cases.

Saugmann has used the method in 21 cases and his assistant Gravesen has reported 16 of them. Holmboe has reported 12 cases; Skärgard a.o. reported 20; Sömme 6; Betrup Hansen, 6; Christoffersen, 3, and Dahlstedt, 2. Up to the present time there have undoubtedly been done more than 100 operations.

I almost always use local anæsthesia and introduce the thoracoscope through the back. The thoracoscope is introduced somewhat higher up when the adhesions are at the apex of the lung and lower down when they are in the lower part. The selection of the point at which to introduce the galvanocautery is of great importance. Because the adhesions in most cases are high and to the side, as a rule I introduce the galvanocautery in the antero-axillary line in the seventh, eighth, or ninth intercostal space. When the adhesions are in the apical region, I introduce the cautery still higher up in the axillary line; when they are near the diaphragm, I introduce the cautery in the lower part of the thoracic wall.

The second and most difficult part of the operation is reached after the galvanocautery is introduced into the pleural cavity, for we must now handle the cautery under the guidance of the thoracoscope. It is for this stage of the operation that one must have the most practice. It is not always easy to find the galvanocautery itself, and to direct and apply it to the adhesions requires a certain experience. I generally apply the platinum needle[1] on the narrowest part of the adhesion. If there is a cavity underneath the attachment of an adhesion, I cauterize it as closely to the chest wall as possible. At the moment of cauterization the pain may become rather severe, but as a rule the pain is fairly moderate, especially when the adhesions are small, string-like, or membranous bands which are easily cauterized in a fraction of a minute. Thick, firm, sinewy

[1] The platinum needle on the cautery.

Fig. 1. Technique of operation. The introduction of the thoracoscope in the patient's back and of the electric cautery in the lateral region.

adhesions sometimes offer very strong resistance, and I have now and then worked with them for 1 or 2 hours. When cauterizing it is of great importance not to have too strong a glow on the galvanocautery; otherwise hæmorrhage may arise. In only one of my 55 cases was there a hæmorrhage and this amounted to 100 to 200 cubic centimeters. Other authors who have used the method report only a single case in which a really dangerous hæmorrhage occurred, which was probably caused by too strong a glow. Since then no death caused from hæmorrhage has occurred in the total number of more than 100 cases. It seems to me that we are justified in considering that this complication is not of sufficient importance to cause us to abandon the operation in favorable cases. A certain degree of danger and uncertainty as regards hæmorrhages, of course, is always present, but if a slight glow is used the danger ought to be relatively small.

COMMENTS ON THE REPORTED 50 CASES

Complications may arise sooner or later after the operation. A skin emphysema, originating from the puncture opening, may occur and cause some trouble for a day or two, but it soon disappears. Of greater importance are the pleuritic exudates which may develop after the operation. Table II gives the different types in my cases.

TABLE II.—EXUDATES

	Cases
1. Without exudate	15
2. With slight exudate	15
3. Long lasting exudate and fever	4
4. Long lasting exudate and fever accompanied by empyema	4
5. Exudate appearing only 1 to 3 months after operation	2
Total	50

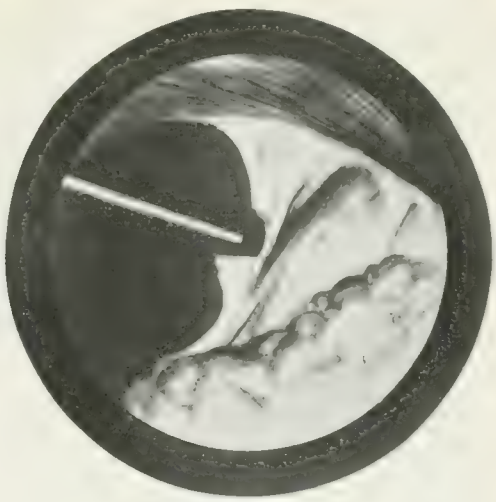


Fig. 2. Picture showing the burning of membranous adhesions between the chest wall and the compressed lung.

The first group of cases quite naturally progressed very favorably. After a few days of fever the patient had the same low temperature as before the operation. The same can be said about the second group, where we had a small exudate which did not reach above the pleural cupola. After 1 or 2 weeks it disappeared without leaving a trace. These pleurisies had, therefore, no influence on the clinical result and it seems permissible to say that in 40 out of 50 cases the operation had no unfavorable influence on the clinical course. The third group comprises four cases, in all of whom there was an exudate, the temperature became high, and the general condition of the patient was unfavorably affected. These conditions prevailed during the 4 to 6 weeks following operation, and were probably the result of an ordinary tuberculous pleurisy. In the fourth group, which also comprises four cases, the pleurisy was at first of a serous nature and thus of the same character as in group 3, but after one or several months, tuberculous empyema developed. In these cases the complication had such a very unfortunate effect that of four cases three died after 1 or 2 years. Without doubt death was due in no small measure to the weakened general condition brought on by the chronic empyema. In the last group the condition was good imme-

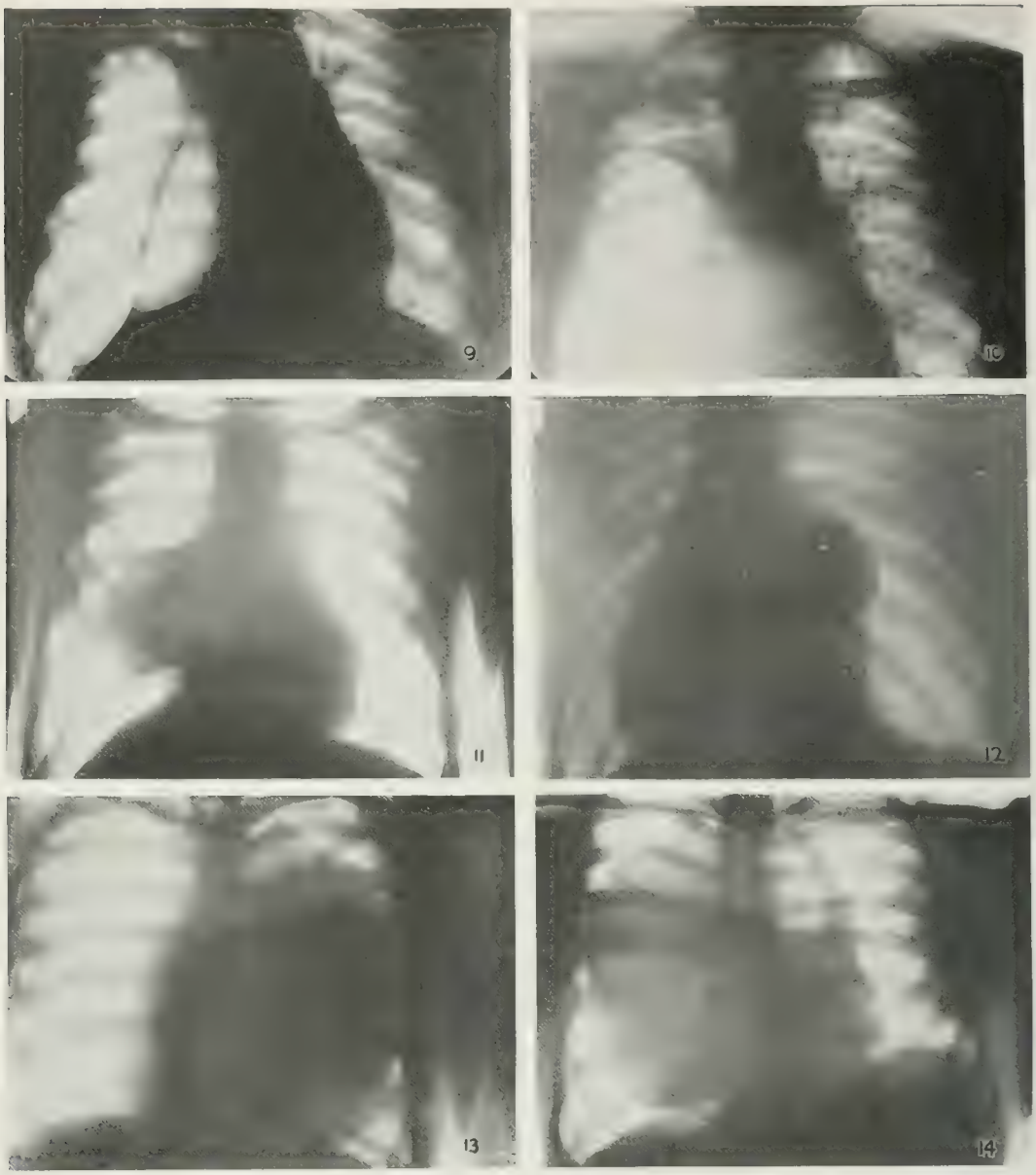
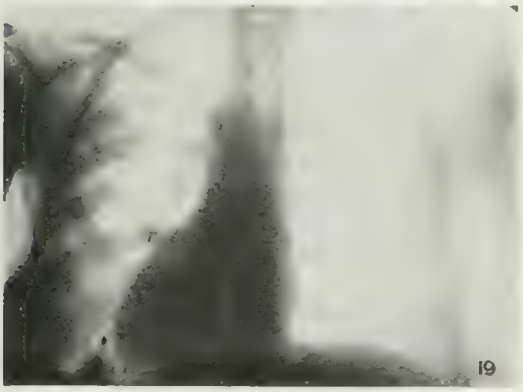


Fig. 9. Case with adhesions to the diaphragm before burning.
Fig. 10. Same case after burning. Karlstrand.
Fig. 11. Case 1 of intrathoracic tumor.
Fig. 12. Case 1 of intrathoracic tumor after introducing a pneumothorax.
Fig. 13. Case 2 of intrathoracic tumor.
Fig. 14. Case 2 after inducing pneumothorax.

diately after the operation, but after a few months an exudate appeared and in both cases the result was an empyema. Both patients nevertheless gradually improved so that the prospects for the future are fairly good. Whether the cauterization had anything to do with the pleurisy appearing so late after the operation is, of course, impossible to decide with certainty. An independent development of the empyema is, in my opinion, probable.



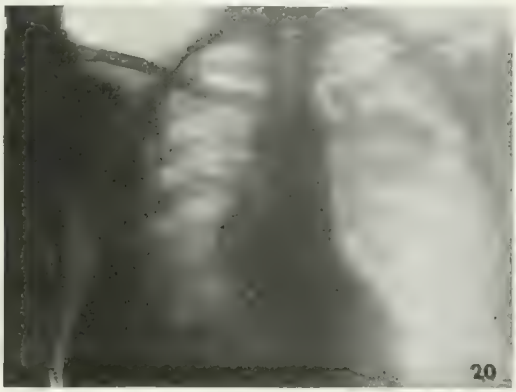


Fig. 15. Case 3 of intrathoracic tumor.
Fig. 16. Case 3 after inducing a pneumothorax.
Fig. 17. Case 4 of intrathoracic tumor.
Fig. 18. Case 4 after inducing pneumothorax.
Fig. 19. Case 5 of intrathoracic tumor.
Fig. 20. Case 5 after induction of pneumothorax.

From other statistics one finds that Gravesen in his 16 cases had empyema in 2 cases and serous pleurisy in 4; in Holmboe's 12 cases there was a slight pleurisy in 1 case and in 1 a severe acute pleurisy with empyema and mixed infection from which the patient died after 4 to 5 days. From these findings it is evident that pleuritic exudate and empyema are the most serious complications of this operation. In my cases the mortality from

these complications was about 6 per cent, which, though it is high, ought scarcely to be attributed to the operation alone. On the other hand, it is evident that this complication is not of such grave importance as to warrant abandoning the method in suitable cases.

I will now pass to the favorable results from the use of the method and in the following tables will show the outcome in the 50 cases operated upon by me. I have arranged the cases in three groups, according to the location of the adhesions in the chest cavity.

TABLE III.—RESULTS OF CAUTERIZATION

Jacobaeus	Number of cases	Complete or for collapse of the lung, sufficient cauterization	In clinical respect good result	Incomplete cauterization
Apical adhesions	5	4	4	1
Lateral adhesions	42	32	30	10
Diaphragmatic adhesions	3	3	1	-
Total	50	39	35	11
Holmboe	12	7	7	5
Gravesen (Saugmann)	16	9	7	7
Total	78	55	49	23

To begin with we have the apical adhesions. They are mostly short and technically difficult to reach with the galvanocautery. When cauterizing, very often pains are felt because of the proximity to the parietal pleura. In 4 cases out of 5 the operation was technically successful and a clinically favorable result was obtained. The second group, lateral adhesions, comprises the largest number of cases. In 32 of them the operation was technically successful and in all of them except 2 a clinically favorable result was obtained. In these two, an empyema with the above-mentioned consequences developed. In the third group, diaphragmatic adhesions, there are technical difficulties, for, during cauterization proper, the patient must hold his breath; otherwise the adhesion is in constant movement. It is an advantage, however, that in such cases the cauterization is entirely painless. In all three cases the operation technically was successful, but only in one case has the clinical result been of value. The lung had extensive adhesions to the upper part of the chest wall, which it was not possible to remove by this method. In removing diaphragmatic adhesions, the aim of the operation is to get better compression of the lung in the upper part of the chest cavity. In my opinion, this is possible only in exceptional cases.

The total sum of cases with clinically successful result is thus 35. Of the 11 cases in which incomplete cauterization only was performed, the clinical result was good in one case. In only one of these cases did a severe protracted pleurisy occur.

With regard to other authors, Holmboe has had 7 clinically successful results in 12 cases. In 16 cases Gravesen had 9 technically successful results and of these 7 became bacilli-free. Two of the incompletely cauterized cases became worse because of empyema and protracted fever, the probable cause of which was undoubtedly an attempt to burn off rather extensive adhesions. In his report we find that cauterizations were made in several séances, each of a duration of from 1 to 2 hours. It is evident that the danger of exudate in such cases must be rather great.

Summarizing the results in the 78 cases reported up to the present time, we find that in 55, or in about 75 per cent of the cases, the method was technically completely successful in removing adhesions which prevented the complete collapse of the lung. Naturally the clinical results are not so favorable, as only 49 cases, or about 63 per cent, have been symptom-free. If we now return to the first table we find that where adhesions are present (Gravesen's group II and III) we can improve the patient's condition to such a degree that the future prospect for good health increases from 33.33 per cent and 11.1 per cent respectively to not less than 70.2 per cent (as in Gravesen's group I). According to the same table the mortality would fall from 66.67 per cent and 86.7 per cent respectively to 23.4 per cent. Whether in reality this has been so in the cases hitherto operated on, I cannot say, first, because the time which has elapsed since the operation is too short and, second, because some patients have been sent to sanatoria and it has not been possible to follow their progress.

A rapid survey of the facts now available would give less favorable figures, as they indicate a death rate of between 30 and 40 per cent. This, of course, has nothing to do with the operation itself. Many factors surely enter into consideration. One reason for the less favorable results may be the fact that the patients were from the poorer classes and therefore were not able to get sufficient nursing. Adhesion cases are often more severe than those in which a complete collapse is obtained.

Although we have not succeeded in getting as good a health percentage as in cases of simple pneumothorax without adhesions, this method ought to be of permanent value at least in a limited number of pneumothorax cases with string-like or membranous adhesions.

TUMOR CASES

I will now describe some tumor cases, in which the operation was performed by our leading surgeon, Dr. Key. Naturally the chief honor for the successful operations in these cases belongs to the operating surgeon, while a small part of the success is no doubt due the preceding special examinations with the X-rays and the thoracoscope. The detailed description of the operations is to be found in *Acta Chirurgica Scandinavica*, 1921, I, No. 6.

Case 1. A man, age 28. By accident an intrathoracical tumor was discovered (Fig. 11). Pneumothorax was established and it was seen that the tumor was separated from the lung (Fig. 12). On thoracoscopic examination a tumor, the size of a goose egg, and with a broad stalk, was immediately found in angulus costarum. This tumor was quite easily removed by Dr. Key.

Case 2. A man, age 23. For the last 6 months he has at times suffered from a pain in the left side and on account of this he was admitted to the hospital. On X-ray examination a very large tumor was found in the pleural cavity quite filling up its posterior part (Fig. 13). Because of the experience in earlier cases, pneumothorax was now established. We could see only the tumor, but could not see its connection with the lung (Fig. 14). Thoracoscopy showed the lung lying rather free of the tumor, and only slightly attached to the tumor on the anterior side. The tumor was free above and laterally. Operation was recommended to the patient and Dr. Key removed the tumor October 13, 1915. Operation was performed without insufflation apparatus and was quite successful. The condition immediately afterward was rather precarious but the patient recovered and has since then been quite well.

The tumors in both these cases were fibromyomata.

Case 3. A woman, age 28, became ill 6 months before, with cough and symptoms of bronchitis. Respiration over the left lung downward was weakened, fever set in, and further symptoms of exudative pleurisy developed. By X-ray examination it was discovered, that the pleurisy was caused by a tumor (Fig. 15). The exudate was drawn off (Fig. 16) and replaced by air, and thoracoscopy performed. Now a large, solid tumor, fairly free from the lung and the chest wall, was observed. The surface was smooth with several lines and a cyst the size of a bean. The pleural surfaces were somewhat reddish with here and there greyish white deposits; it was impossible to decide whether they consisted of fibrin or were metastases. The exudate was hæmorrhagic and the cells of the exudate were microscopically found to be of an endothelial type, thus indicating a malignant tumor. It was only after rather long consideration that we decided to operate. Dr. Key performed the operation and it was rather difficult to remove the tumor, as it was attached to the aorta. The patient was much exhausted after the operation but recovered quickly and is now, 5 years after the operation, in perfect health.

As far as I know this is the first time that a tumor with hæmorrhagic exudate, with all clinical symptoms of malignancy, has been operated on with a lasting, good result. From a pathological and anatomical point of view, the tumor was very peculiar. The pathologists considered it to be a xanthosarcoma.

Case 4. A woman, age 47, who always before had been healthy, consulted the doctor because of pains in the left shoulder and the left arm. By X-ray examination a tumor was discovered, which filled up the whole of the pleural cupola on the left side (Fig. 17). I wish to point out that as regards the clinical symptoms, not only the ordinary physical ones of the chest but also the Horner symptom complex, i.e., sympathetic paralysis of the diseased side, could be proven. Pneumothorax was induced, and the lung was seen as an appendix of the tumor and as such to continue downward (Fig. 18). Thoracoscopy confirmed the intrapulmonary site of the tumor. Thoracotomy was also performed, but, as was expected, the tumor was found to be inoperable because it had grown into the mediastinum.

Case 5. A woman, age 44, was admitted to the hospital on account of a slight hæmoptysis. On

X-ray examination the formation shown in Figure 19 was observed in the left lung. An exhaustive examination gave a negative result, and the conclusion was drawn that this was an isolated disease in the lung, either tumor or tuberculosis, with a leaning toward a diagnosis of tumor. Echinococci do not exist here. Pneumothorax was induced and thoracoscopy performed without any other result (Fig. 20). Dr. Key removed the tumor which proved to be a solitary tubercle. The diagnostic mistake in this case was, however, fateful as a tuberculous pleurisy with tuberculous infection of the thorax wall ensued. The patient became worse and died in a short time.

The interest in these cases centers naturally around the use of pneumothorax and thoracoscopy for the local diagnosis of intrathoracic tumors. In case of pleuritic exudate, Brauer in Hamburg is the first one who has shown that on X-ray examination after drawing off the exudate and replacing it with air, more beautiful and more illuminating pictures of existing tumors can be obtained, than when the exudate remains. The above related cases mark only a further development of this observation, since pneumothorax has been established in cases without exudate thus making it possible to examine them with the X-ray and thoracoscope.

In our summary Key and I have arrived at the following conclusions:

CONCLUSIONS

1. For the diagnosis and localization of pleural and pulmonary tumors it is of great importance to make an X-ray examination before as well as after the induction of pneumothorax. By making an X-ray examination after the induction of pneumothorax valuable information is obtained, which completes the information already obtained by the X-ray examination before the induction of pneumothorax.

2. Thoracoscopic examination gives valuable information in diagnosing and localizing pleural and pulmonary tumors, and verifies the X-ray examination.

3. If it is not possible to use a pressure-difference apparatus, it might be advantageous to induce pneumothorax previous to operation in the pleural cavity.

4. If a pressure-difference apparatus be employed, then pneumothorax for the thoracoscopic examination ought to be induced as shortly before the operation as possible, in order that the inflation of the lung after the operation may not be rendered more difficult or impossible.

5. If the lung is inflated after the operation, more favorable conditions for the course of healing are eventually obtained.

LARYNGECTOMY[1]

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THE operation of laryngectomy is not popular. Among the reasons for this unpopularity may be enumerated the following:

The magnitude of the procedure; the great extent of the cellular spaces opened to infection; the impossibility of avoiding some contamination of the wound from the throat, and the consequent danger of sepsis; the difficulties connected with the feeding and nursing of the patient during convalescence; the certainty that in extrinsic cancer, under which heading come the majority of cases, the deep cervical glands are contaminated very early; and, finally, the great tendency of the disease to recur.

It is safe to say that the greatest obstacle to success was removed by the introduction of the nasal tube for feeding purposes. The simplicity of the device and the ease with which it is tolerated leave nothing to be desired.

My first complete extirpation was performed in 1894. I had not then the advantage of the nasal tube and the patient died in a fortnight from bronchitis set up by the escape of food stuffs into the trachea. For some years I did not try again, particularly as about that time the operation met with a good deal of adverse criticism from competent judges, but in 1909, after the introduction of the nasal tube, I operated on a man aged 42 for squamous cancer of the right side of the larynx.

This was at the time when Wright was working at his opsonin theory, and, thinking we should give the patient the benefit of Wright's labors, we had prepared an autogenous streptococcal vaccine, and left instructions that the dose prescribed by Professor O'Sullivan should be injected.

At the operation, when I was assisted by Mr. Edward Taylor, a preliminary tracheotomy was performed and the larynx dissected out. A number of obviously carcinomatous glands were found adherent to the right internal jugular vein, necessitating resection of that vessel for about 2 inches. The trachea was sutured to the skin at the suprasternal notch. The wound was closed by a plastic operation, and a nasal tube inserted through which the patient was fed during convalescence. His temperature never rose above 100° F. and we regarded the absence of fever as attributable in some degree to the influence of the vaccine. We remained under this impression for long enough and it was only after the resident pupil, to whom the duty of injecting the vaccine was deputed, had long left the hospital that I discovered that the injection had been given to the wrong patient.

The man made an excellent recovery. The only treatment subsequently adopted was a series of X-ray exposures over the right side of the neck in the situation where the jugular vein had been excised. I saw the patient at intervals for some years, he carried on his occupation as coalheaver in all weathers without even the inconvenience of a cold on the chest. I constructed a speaking apparatus which I demonstrated at the Laryngological Section of the British Medical Association, at its Belfast meeting. This consisted essentially of a reed inserted into the end of a rubber tube. The tube was passed, reed foremost, through the nose into the pharynx, the outer end could be connected with the tracheal opening and, when blown by the patient, the reed made the requisite noise in the pharynx which enabled the patient to speak with a clear if monotonous voice. But not being of a high intellectual type he could not be made to use the device, preferring to get annoyed when those about him failed to catch his meaning, rather than take the trouble of making himself heard with the apparatus.

I find he died in the South Dublin Union Hospital in April, 1913, more than 4 years

[1] Presented before the Clinical Congress of American College of Surgeons, Philadelphia, October 24-28, 1921

after the extirpation. There was no recurrence local or general, but he was in poor health and death was ascribed to heart failure.

Case 3. A gentleman, age 51, who was sent to me by Dr. Hamilton, of Boyle, in November, 1909. He complained of pain and difficulty in swallowing for about 2 months, the pain latterly increasing in severity and shooting toward the right ear, while the dysphagia was so great that only fluid and semi-fluid foods could be taken.

The right side of the larynx was occupied by a cancerous growth having an ulcerated surface presenting backward and outward toward the sinus pyriformis and the opening of the gullet. A gland or two over the carotid sheath at the level of the upper border of the thyroid cartilage were palpably enlarged.

An autogenous staphylococcic vaccine was prepared and administered 2 days before the operation. After preliminary tracheotomy the larynx was removed, a rubber nasal tube was inserted into the stomach, and the pharyngeal and skin wounds closed by sutures. The patient went on fairly well for some days. His temperature remained below 100°F., but he suffered considerably from cough and bronchitis accompanied by profuse purulent liquid expectoration, and his sleep was meager. On the fifth and several subsequent days he bled repeatedly the amount aggregating about 2 pints. It was then observed that the wound showed no tendency to repair but rather to ulcerate. The granulations were poor and the tissues seemed to melt away. A silkworm suture by which the trachea was anchored to the skin in front of the suprasternal notch, cut through, and the resulting ulcer, so far from healing, gradually eroded the skin until it reached about 3 centimeters in diameter.

The bleedings continued until the twelfth day and appeared to be due to the ulcerative process only. At this time the wound presented a startling appearance. Every stitch had cut through, and no two surfaces had united. The trachea was isolated and surrounded by sloughing areolar tissue, through which it rose and fell with great amplitude of movement during coughing. The pus from the sloughing tissues was very profuse, and it was only by unremitting care on the part of the nurses that it could be kept from overflowing into the trachea. A suction apparatus, such as was devised by me, and described in the *Transactions of the Royal Academy of Medicine in Ireland*, vol. xiv, 1896, rendered the most admirable service in preventing the pus from overflowing into the trachea.

On the sixteenth day after operation a decided improvement took place in the appearance of the granulations, and by the end of December healing was practically complete, but the upper borders of the trachea and gullet had epithelialized, thus establishing a fistula between the two tubes. On January 19, 1910, with Sir Charles Ball's assistance, I closed the fistula, but no union took place and the edges separated. On January 29 I removed the glands over the carotid sheath, Sir C. Ball assisting. One of the glands was so adherent to the jugular that it was necessary to excise between 2 and 3 inches of that vein. The glands when examined were found to be cancerous. The wound healed by immediate union.

During all this time food was given by the tube introduced through the fistula. In February I devised a tracheal tube on the principle of Hahn's cannula, by which a rubber covering could be inflated so as to block the fistula, and permit swallowing by the mouth. He left the nursing home on March 19, and was recommended to present himself for examination at least monthly.

After some months, on October 19, a tumor of considerable size—about that of a walnut—was found on the right side of the neck, the center of the growth corresponding to the level of the bifurcation of the carotid. It was stony hard, and an obvious recurrence of the disease. There was no ulceration in the pharynx.

It was decided that an attempt should be made to remove it. We found that, as not uncommonly happens, the condition was worse than appeared from external examination. The growth involved not only the common carotid artery but the prevertebral muscles. Mr. E. Taylor, who assisted, entirely agreed with me that it was inadvisable to proceed further. Complete removal could only be accomplished by exposing a healthy portion of the common carotid, ligaturing it, and dissecting the cancerous mass up from below, and sacrificing the pneumogastric nerve—an operation that would almost certainly have been fatal, while it gave little or no prospect of eradicating the disease. The lower portion of the mass involved the thyroid gland. Accordingly, the operation was abandoned, except that a small portion was removed for microscopic examination. This proved to be cancerous.

On October 28 Sir Charles Ball suggested that thyroid extract should be given and quoted two cases of inoperable cancerous lymphatic glands in which that remedy had been tried with success, though he had tried it in others without any good effect. Three-grain doses of the extract in the form of tabloids (B. W. & Co.) were prescribed three times daily.

On November 22—that is, a calendar month after the last operation—the patient came to me complaining of discomfort at the front of the neck low down to the right of the tracheal opening. The skin was tense and fluctuating, but there was no redness. A small incision was made and several drachms of curdy matter evacuated. After 3 or 4 days no more discharge appeared, and the wound was allowed to close.

The treatment by thyroid extract was continued without interruption from October 28. At the end of 3 months (January 24, 1911) it appeared to me

that the growth was not quite so large. At the end of 4 months there was no possible room for doubt on the matter. The infiltration round the glands had disappeared, and the glands themselves were certainly smaller; and at this time (February 27, 1911) the patient reported that for the last week he had been quite free from the shooting pains of the right side of the neck which had been in existence for a considerable time previously.

The glands continued to diminish in size. Early in March the dose of thyroid was increased to 12 grains per diem. The patient had previously tried to take this amount, but could not tolerate it. On March 27 there was no more than a suspicion of any abnormality in the neck, and 6 months after the treatment was started no evidence of tumor could be felt.

The patient remained well until June, 1912, when another recurrence took place behind the angle of the right jaw. This, when first seen, was inoperable and he died in August, 2 years and 9 months from the date of operation.

It is interesting to note that the administration of the vaccine in this case did not prevent, if, indeed, it did not cause, the most extensive sloughing.

Case 4. Miss F., about 50 years of age, was sent me by Dr. Walsh of New Ross at the end of January, 1910.

She had carcinoma of the gullet involving the left wall of the larynx. She had suffered from dysphagia for an indefinte but fairly long time and when I first saw her was reduced to a condition of great emaciation. I wrote her doctor saying I feared the case was too late but that it was a choice between laryngeal extirpation and leaving her to die. The patient was so distressed that she desired operation even though the position was fully explained to her.

I operated on February 15, 1910. It was more like a postmortem examination than an operation. The patient was unable to walk to the theater but she nevertheless bore the operation well.

The cancer had completely encircled the gullet so that it was necessary to remove about 3 inches of the œsophageal walls. I brought in a flap of skin from the neck to fill the gap made by excising the gullet. The trachea was brought out through a transverse slit above the suprasternal notch. For some days the patient gained ground rapidly. Her temperature was hardly, if at all, raised but she died from exhaustion 12 days subsequently.

I believe it was only its extreme lateness that prevented this operation from being one of at least average success and I cannot think that it in any way shortened her life.

Case 5 was similar but much more advanced. Mrs. R., age 47, consulted me in March, 1910, for difficulty in swallowing. On the advice of her doctor she had had all her teeth removed about 2 months previously.

A tumor was palpable on the left side of the neck below the larynx. The upper edge of a cancerous ulcer was just visible in the left sinus pyriformis and involved the posterior wall of the larynx. The left arytenoid cartilage was fixed. I pointed out that the only hope lay in removal of the larynx but that the chances were considerably against its success.

The state of affairs was much worse than I thought. The mediastinum was extensively invaded and the posterior tracheal wall infiltrated. A satisfactory removal of the disease was impossible. The patient bore the operation well. Temperature and pulse were good for some days afterward, but she died 8 days later without pain and without distress.

Case 6. I operated at Sir P. Dun's Hospital on October 25, 1910, on a man aged 60, whom I saw in consultation with the late Dr. Randal Counihan of Ennis. The whole of the left side of the larynx and the left sinus pyriformis was occupied by a flat-celled cancer which had caused him hoarseness and a "catch" in his breathing for 2 months.

Five days before operation he was given a vaccine of mixed staphylococcus and streptococcus.

The patient bore the operation well. Temperature only slightly raised, was in good spirits the night but one after the operation, but toward morning his pulse began to fail and he died at daybreak. It is hard to say why he did not make a better fight. He had not been a temperate man.

Case 7. Mrs. O., age 32, was operated on at Sir P. Dun's Hospital on St. Stephen's Day, 1911. She had suffered from dysphagia for some months. A carcinoma was found behind the cricoid cartilage completely encircling the gullet. She was most anxious to live, particularly as she had a baby only a few months old. Total extirpation was performed as the back of the larynx was involved in the growth. In this case, too, a great deal of difficulty was met in dealing with the gap left in the gullet. It was grafted immediately by Thiersch's method but the grafts, if they adhered at all, did not prevent cicatrization and contraction of the food passage. This had accordingly to be kept open by a rubber tube. This tube was inserted through a wound in the middle line of the neck kept open for this purpose. The patient by this device was able to eat and swallow with the greatest freedom. So much so that she put on flesh rapidly and was not to be recognized from the same person 3 months afterward. After 6 months, however, she developed a recurrence of the disease from which she soon died.

Case 8. A gentleman, age 58, sent to me by Dr. Lavery of Dundalk in January, 1912. He had complained of hoarseness, sore throat, and a lump on the right side of his neck under the angle of the jaw, for more than a month.

Examination revealed a tumor of the right lateral and posterior walls and the pharynx low down, and

the right side of the larynx. The right vocal cord was fixed. The glands in the right side of the neck lying over the jugular sheath were so large and fixed that it was pretty certain that the vein itself was involved. The tumor was obviously a carcinoma and microscopic examination of a portion confirmed the diagnosis.

On January 19, 1912, assisted by Mr. Edward Taylor, I operated on the secondary growth. A long chain of glands lay over the great vessels of the neck on the right side. Their removal necessitated resection of the jugular vein for about 5 inches. The operation was well borne. Twelve days later I removed the larynx. His recovery was uneventful.

Six months later he developed a recurrence on the right side under the sternomastoid, and he died in August, 9 months after the operation.

Case 9. A man, age 63, was sent to me by Dr. Boyce of Enniscorthy complaining of sore throat for about 3 months. A tumor which proved to be a squamous cancer was found to occupy the left lateral laryngeal wall. There were no glands palpable. The lumen of the larynx was greatly encroached on and his breathing, though not obstructed, was slighlty affected.

I removed the larynx on August 20, 1912. The case was much worse than I had any reason to expect. The growth encroached on his gullet to such an extent that it was only possible to construct a very small tube, the size of a No. 10 catheter, from what was left. The thyroid gland was greatly hypertrophied and slightly compressed the trachea laterally from the left side. The patient made a good recovery, but I am informed that 5 months later he developed dyspnœa from pressure from something outside the trachea which could not be relieved, and he died of suffocation. Whether this was due to pressure from the thyroid gland which had been observed to be enlarged at the time of operation, or to recurrence of the disease low down in the neck, it is impossible to say.

Case 10. A man, age 62, complaining of hoarseness for a year was sent me by Dr. Killen of Londonderry. A cancer was found on the right side of the larynx. It had apparently started on the vocal cord but at the time of examination had crossed the middle line in front and involved the arytenoid cartilage behind. This was a case that, had he presented himself in time, could have been dealt with by the simple operation of median thyrotomy, but the extent of the disease when Dr. Killen and I first saw him was too great for any chance of success by this method. He had never anything to complain of but persistent huskiness and it cannot be too often repeated that no case of the kind should be allowed to run on without having the larynx examined carefully. The patient, who was operated on August 27, 1912, did well and is still in good health.

Case 11 was a similar but more advanced one which was sent me by Dr. Moran of Gort, County Galway, in September, 1912. He first complained of hoarseness 5 years previously and he now found himself choking. A piece of the growth removed with the double object of relieving the dyspnœa and for microscopic examination, proved to be a carcinoma.

Nothing short of complete removal of the larynx was to be thought of, and this operation was accordingly performed on September 10, 1912. The patient made a rapid and uninteresting recovery, and is, so far as I know, still in good health.

Case 12 was sent me on November 1, 1913, by Dr. Wynne of Westland Row. A gentleman aged 61 complaining of difficulty in swallowing of 10 days' duration, with darting pains toward the left ear.

I found a squamous epithelioma of the left side of the larynx and sinus pyriformis. The glands over the left jugular sheath were enlarged.

On November 19, 1913, I performed total extirpation of the larynx and removed the glands over the left jugular sheath. He bore the operation well. The wound healed by first intention, but an abscess containing some necrotic tissue developed between the gullet and the skin above the tracheal opening. A small fistula developed which healed after a few days. The patient did well and remained well until early this year, 1921, when he again fell the victim of cancer low down in the pharynx from which he succumbed in March, 7 years and 4 months from the date of the extirpation.

Case 13. A gentleman, age 64, who consulted me in June, 1914, for dysphagia of some months' duration. I found the right pharyngeal wall and side of the larynx involved in a carcinomatous tumor. A piece was as usual submitted for microscopic examination and the diagnosis confirmed. The glands in the anterior triangle of the neck were extensively engaged.

On July 7, 1914, I performed total extirpation of the larynx, at the same time removing the infected glands. He bore the operation well, and the wound healed kindly enough though there was some local necrosis of cellular tissue. He had one burst of hæmorrhage at the end of the third week, and a small fistula developed at the lower end of the wound above the trachea. This too healed and I was able to remove the feeding tube after 4 weeks from the time of operation. Three months later he developed some cancerous glands on the right side of the neck which I removed after a very laborious dissection. He remained well until March, 1915, when a further recurrence took place. I was ill at the time with influenza and Mr. Edward Taylor, who had assisted me at the previous operations, attempted their removal. He found too many important structures involved and did not proceed. The patient died in August, 14 months after the first operation.

Case 14 was that of a lady aged 50 who on the advice of Dr. Powell of Roscrea consulted me in September, 1914, for difficulty in swallowing and in association with pain shooting toward the left

ear. She said her throat had always been delicate and that she had always been compelled to swallow but small amounts and slowly lest she choke.

Mr. Edward Taylor saw her in consultation with Dr. Powell and me. She had an ugly, ulcerating growth occupying the left sinus pyriformis. A specimen proved our diagnosis of carcinoma to be correct. Although she was a fragile-looking woman we recommended an extirpation of the larynx as the only chance of prolonging her life. This was carried out on October 9, 1914. We found the case even worse than the appearances led us to expect. The cancer extended downward into the gullet and traveled round in a horseshoe shape so as to leave us very little of the unattacked wall to form a tube. Not only this, but in addition to a primarily large cancer, there were two independent nodules: a small one just below the primary growth and a larger, about the size of a hazel nut, deeper down the gullet. We succeeded in removing everything that was recognizably diseased, but in view of the extent and multiplicity of the infection, we had but little ground to hope for cure. She bore the operation admirably and she had neither fever nor cough. Owing to the contracted gullet we had to keep in a kind of modified Symond's tube after the nasal tube had been withdrawn, but recurrence took place and she died 8 months after the operation.

Case 15 was that of a gentleman, age 64, who was sent to me by Dr. Gogarty on December 1, 1914. He had been hoarse since the previous April. There was no pain and difficulty in swallowing. Dr. Gogarty had removed a piece of tissue which proved to be cancerous. The tumor was situated on the right vocal cord and interfered with the arytenoid movement.

On December 4, assisted by Dr. Gogarty, I removed the whole larynx. The patient made an uninterrupted recovery and was able to leave the nursing home on the twenty-sixth day after operation. He remains well.

Case 16 was that of a schoolmaster, age 50, sent to me by Dr. Holmes of Killaloe on June 11, 1915. He had been hoarse for 12 months. He had a tumor on the right side of the larynx occupying the site of the vocal cord. This proved on microscopic examination to be squamous epithelioma. I performed thyrotomy in Sir P. Dun's Hospital the following week. It was found that the cancer was more extensive than it appeared through the laryngoscope. Extirpation would have been the ideal operation, but in view of the patient's occupation he was most desirous that if possible he should not be deprived of his larynx. He was told that a further operation might be necessary. He came again the following October with great difficulty in breathing. It was necessary to perform an immediate tracheotomy. Two days later, on October 26, I excised the larynx. The wound healed by first intention and he left hospital in a month. After a few lessons he developed a good loud voice and was able to carry on his work as a teacher, but he died from a recurrence in April, 1917, a year and 10 months after extirpation.

Case 17. A gentleman, age 56, was brought to me by Dr. Gogarty on January 21, 1916, complaining of hoarseness since May last. He had no other symptom. Although he had been laryngoscopically examined when not in this country the previous summer, the nature of the disease was not recognized. At the time of our examination the situation of the left vocal cord was occupied by a growth which fixed the arytenoid cartilage. Total extirpation was performed with Dr. Gogarty's assistance.

The patient did very well in all essentials. His temperature was never higher than 99 F. but a good deal of cellular sloughing took place, especially on the left side where the stitches cut out and the whole wound opened up. The case nevertheless did extremely well and healing progressed rapidly. He remains well and has developed an excellent voice, so much so that he has no difficulty in using the telephone or in making a formal speech. He insisted on going to France where he drove an ambulance in all weathers until the armistice. His speech is so perfect that people who do not know do not suspect him of having been operated on.

Case 18. A naval man was sent to me on August 4, 1915, by Dr. Killen of Londonderry, complaining of hoarseness for 12 months. The cause was found to be cancerous tumor of the right vocal cord. It was strictly intrinsic and I removed it on September 14 by a median thyrotomy. His recovery was uneventful.

On April 20, 1916, the patient came to me with dyspnœa, and I then found the cancer had recurred. I removed through the mouth enough of the tumor to give him relief. This proved on microscopic examination to be cancerous and the following day, Good Friday, I extirpated the larynx. He did well, had no fever, and the feeding tube was removed at the end of 3 weeks. I last saw him in December, 1918. He is still well.

Case 19. A man, age 54, consulted me on November 13, 1916, complaining of hoarseness of 2 years' duration. I found a growth in the right side of the larynx occupying two-thirds of the right vocal cord posteriorly. A piece was removed and examined and proved to be cancerous. I extirpated the larynx on December 5. The patient bore the operation well, his temperature was never more than a degree above normal, but owing to his extreme thinness the plastic operation was difficult and the transverse wound opened at the end of the first week. With this exception, all went well until 3 weeks after operation when he was attacked with profuse hæmorrhage in two places; one on the left side of the wound and the other just at the opening of the trachea. The assistant surgeon was at hand and stopped the bleeding.

During the fifth week of his convalescence a tumor grew on the right side above the tracheal opening and under cover of the sternomastoid muscle. At the end of this week profuse hæmorrhage occurred

from just above the tumor and before I could reach the patient he had lost a good deal of blood. I consulted with Mr. Edward Taylor and we agreed to open up the tumor and look for the bleeding point. The operation was done at midnight, a branch of the superior thyroid artery was found at the bottom of a hæmatoma and ligatured. The chief difficulty in connection with these hæmorrhages was that the blood gravitated into the trachea and caused coughing which embarrassed those who were trying to stop the bleeding. He finally made a good recovery but died in July, 1917, but from what cause I am unable to say. It was probably not a recurrence of the disease.

Case 20 was that of a gentleman who first consulted me in February, 1907, for dysphagia. He was then aged 40. He had a deep ulcer in the right base of the tongue encroaching on the epiglottis. This proved on microscopic examination to be a carcinoma. I removed the growth by a suprahyoid pharyngotomy, first tying the linguals and dissecting out the glandular infection. The patient remained well until June, 1909, when I found it necessary to operate for malignant glands in the right side of his neck under cover of the sternomastoid. The patient remained well until May, 1917, 10 years after the first operation when he developed a cancerous ulcer in the right side of the larynx. Extirpation was carried out on May 2, 1917. The patient made good progress for 3 weeks when he developed a septic cellulitis under the left shoulder blade behind. This was freely incised and a large area found to be infiltrated though there was only a trace of pus found. On May 28 the left wrist became infected and he succumbed to the pyæmia the following day.

Case 21 was remarkable as much for its extent as for the success that attended our efforts. A gentleman, age 51, was sent to me by Dr. Sandford of Cork on May 18, 1917. On examination I found a large necrotic tumor occupying both valleculæ, pressing the epiglottis out of view, and involving the base of the tongue on both sides, the lateral walls of the pharynx, and the sides of the larynx. The tumor was in contact with the posterior pharyngeal wall so as to impede his breathing. The glands over both carotid sheaths were enlarged. The patient was extremely thin and pallid. I told him, as he had been told before, that operation offered him no prospect of cure. He, however, was very unwilling that nothing should be done, and I reluctantly consented to make the attempt. Accordingly on May 25, I extirpated the larynx and removed a large portion of the base of the tongue, having first dissected out the infected glands in both anterior triangles. The patient never looked back, his recovery was quite without incident, and he still remains well.

Case 22. A gentleman, age 66, was first seen by me in consultation with Mr. Wheeler, 1917, complaining of sore throat. A malignant ulcer was found on the right side of the larynx involving the epiglottis. The glands were enlarged in the right anterior triangle. With Mr. Wheeler's assistance I extirpated the larynx on May 30. A dissection was first made of the glands which were found to be adherent to the jugular vein, 3 inches of which vessel were removed with the glands. The right lingual artery was tied, and the pharynx opened from the left side. The base of the tongue was found to be extensively involved, but a satisfactory removal of the whole growth was accomplished. The patient bore the operation well and was able to leave the Home in less than a month. Glandular recurrence, however, took place and he died a little over 12 months from the date of operation.

Case 23. A gentleman, age 66, was seen in consultation with Dr. Richard Hayes on September 8, 1917, and found to have a rapidly growing tumor of the right vocal cord involving its whole extent. This was removed by median thyrotomy on September 10. The growth was found to be much deeper seated than it looked and to transgress the middle line, but the operation was not unpromising.

On October 10 a granular mass was apparent at the commissure—a specimen removed proved to be flat-celled cancer. Laryngectomy was recommended and carried out on October 17, care being taken to remove the old thyrotomy cicatrix. No enlarged glands were found. The operation presented no difficulty, it occupied just under 2½ hours. At the beginning of the third week there was a little bleeding, about a drachm or two, but no great importance was attached to it. The following day bleeding to the extent of 5 or 6 drachms occurred and the patient got a severe rigor. A diagnosis was made that one of the veins of the neck was infected owing to some necrosis of the tissues in its neighborhood.

On consultation with Mr. Edward Taylor we decided that it was better to open the wound and deal with the evil, as we considered pyæmia an imminent danger. This was done the same afternoon but before the operation the patient developed a second rigor showing that the first was no mere accidental affair. Some septic fœtid clots were cleared from the wound. The pharynx was found to have healed completely over except at the base of the tongue where the feeding tube was visible. The hæmorrhage was found to have come from the right side of the neck and on removing an adherent clot a long thrombus was withdrawn from the right jugular vein which was found to have a gap in its front wall. The tissues were stitched across the defect with two catgut sutures. Great care was necessary as there was extremely little tissue in front of the common carotid artery. A plug of gauze saturated with "bipp" was placed over the wound and the patient put back to bed. His temperature fell at once and remained normal. The reopened wound did not adhere well and a plastic operation was performed 10 days later. The patient is still in excellent health.

Case 24. A woman, age 47, consulted me at Dun's Hospital for pain in the throat and difficulty in swallowing for more than a year. It was an advanced case of carcinoma, but I agreed to operate and carried out an extirpation on November 27, 1917. The case did well subsequent to operation but the disease recurred. A Symond's tube had to be worn for feeding purposes. Patient died 13 months after the date of operation.

Case 25. A man, age 47, was seen by me at Dun's Hospital in January, 1918, for hoarseness and pain in the throat of 9 months' duration. He was a man of intemperate habits. I found the larynx cancerous and after an interval of a fortnight for the purpose of allowing him to recover from a bout of drinking I performed an extirpation on February 12. There was nothing unusual in connection with the operation which he appeared to bear well, but the wound became septic and he died suddenly of hæmorrhage 12 days later.

Case 26. A man, age 62, consulted me in April, 1918, for hoarseness. Examination showed a malignant tumor in the larynx.

Extirpation was performed on April 24. Recovery was uneventful and he left Hospital on May 29. He remains well.

Case 27. A gentleman, age 61, was seen by me in consultation with Dr. Gogarty in October, 1918. He had a cancer of the vocal cord. The arytenoid cartilage was fixed. I extirpated the larynx on October 23. The wound was healed and the patient able to eat in 3 weeks. He has an excellent voice and remains well.

These operations may be divided roughly into two classes: those in which the larynx alone was involved, and those in which the hypopharynx or the gullet proper was involved. In the latter class, which for convenience we may term gullet cases, the results were poor. Recurrence of the disease was invariable and in those cases where life was prolonged over a matter of months, there was always some difficulty about the management of the apparatus designed to keep the gullet open, which necessitated the patient living within reach of the operator.

Cancer involving the food passages low down in the neck is still, so far as my experience goes, one of the most hopeless with which one can be confronted. Two of my cases died within a fortnight of operation while the other three survived for about 6 months.

Of these cases in which the larynx only was affected there are 22. For purposes of consideration of the results I shall take leave to except the first, performed in 1894, when the operation was still rudimentary. Since 1909 I have operated on 21 of these. The results are as follows:

3 died within a month
2 died within a year
4 died within 2 years
1 died within 3 years
1 died within 5 years
1 died within 8 years

while 9 are still alive from 3 to 9 years after operation.

A few words are due on the condition of such people as regards comfort and general enjoyment of life. It may be said at once that so far as one can see they are, in essentials, hardly worse off without the larynx than with it. Swallowing is not interfered with, while the tendency to bronchitis, which everyone assumes when the protection of the upper respiratory passages is abolished, seems to be not greater than, or even as great as, among ordinary folk.

There remains the problem of speech. At first blush it seems absurd to expect a man to speak without a larynx, but nevertheless, speech may be quite perfect, and without the aid of any apparatus. In fact I do not regard my result as perfect unless it includes loud, distinct, and perfectly audible speech. This, however, depends less on the operator than on the intelligence and quickness of the patient.

As soon as the feeding tube is removed I begin teaching my patient the art of gulping air into his œsophagus and allowing it to escape as a belch. The physical difficulty of this act is much less where the larynx has been removed than in normal people, because the cricoid cartilage ordinarily remains in close contact with the posterior wall of the gullet, and it requires considerable effort on the part of the mouth to overcome its resistance. With a view to giving the patient an object lesson in the art of belching to order, I sometimes administer a draught of a solution of citric acid followed by a neutralizing one of bicarbonate of soda. The carbon dioxide evolved, sooner or later escapes with a noise that makes a perfect substitute for the voice, and the patient is instructed to watch

his opportunity and to form it into a vowel in its transit. When this is once accomplished it only remains for him to acquire the trick of keeping an air reservoir in the œsophagus in order that he may speak audibly and continuously.

I was first instructed in the possibilities of this method in or about the year 1893 by a patient on whom laryngectomy had been performed by Dr. Cohen, of Philadelphia, who accidentally discovered this method and who cultivated it with such success that he had no difficulty in making himself heard in a room that ordinarily held three hundred people. I availed myself of the opportunity of his being in Dublin to show him at a meeting of the Surgical Section of the Royal Academy of Medicine at that time, and I had considerable difficulty in persuading some of the members that the voice really owed its strength and quality to air escaping from the gullet.

This series includes five cases which were strictly intrinsic cancers. The proper method of attacking such cases, if they only present themselves in time, is unquestionably that of thyrotomy. The results from this operation are most satisfactory, and from my own experience I can confidently recommend it. Recurrence in suitable cases is rare and it is no uncommon thing for such patients to remain cured indefinitely.

The question as to the point at which an intrinsic cancer becomes unsuitable for attack by thyrotomy is an interesting one, and one of great practical importance. When the cartilaginous framework of the larynx is diseased there is no room for doubt. The growth is then virtually extrinsic, and long before such a stage is reached a clean removal by simple thyrotomy is impracticable. The earliest moment at which I personally decide on the larger measure is when the growth on the vocal cord has extended sufficiently to cause fixation of its neighboring arytenoid. For though in such a case all disease might be removable by thyrotomy, yet if that removal involves sacrifice of the arytenoid cartilage, it can hardly fail to cause insufficiency of the larynx. This happened in one of my cases of thyrotomy. Insufficiency of the larynx leads sooner or later to bronchitis and death. Therefore, whenever the arytenoid cartilage is fixed we must deem the line dividing the cases suitable for thyrotomy to have been transgressed, and total extirpation must be regarded as an operation of less danger than thyrotomy.

The operative method I follow is described in Mr. Edward Taylor's book on *Operative Surgery*. It may be shortly summarized as follows: No preliminary tracheotomy is performed unless dyspnœa is present: Even then it is preferable to pass a rubber respiration tube through the larynx in all but urgent cases. Two incisions are made, one across the neck immediately below the hyoid bone, exposing the thyrohyoid membrane. A median vertical incision is carried from this to the suprasternal notch. The two triangular flaps thus outlined are reflected outward laying bare the extrinsic muscles of the larynx. These are then lifted on blunt dissectors and cut away, leaving the framework of the larynx bare. The superior laryngeal vessels are secured at the place where they traverse the thyrohyoid membrane. The cricothyroid and inferior laryngeal vessels are similarly dealt with. The next step is to sever the inferior constrictor fibers at their insertion into the posterior border of the thyroid. This exposes the mucous membrane of the pharynx. Before opening the pharynx, the wound is liberally treated with tincture of iodine, and any recesses are packed with gauze dipped in that solution. The pharyngeal mucous membrane is then snipped through, following the border of the thyroid cartilage (or, as it should be called, bone) cutting through the thyroid membrane and the mucous membrane at the base of the tongue in the vallecula. Following round the same structure on the opposite side in inverse order, we arrive at the lower corner of the thyroid cartilage when the whole larynx lies free in the wound.

The next step is to incise the anterior wall of the gullet behind the cricoid cartilage so as to connect the beginning and end of the incision just described. This should be done as high up as is compatible with keeping clear of the disease. The importance of this

lies in the fact that the higher the wall above and behind the posterior wall of the trachea, the less likely we are to have a fistula into the food passages, and the less trouble it will give us if it occurs. The mucous membrane of the gullet is next stripped back from behind the cricoid cartilage. The larynx is thus held only by its connection with the trachea; and a few transverse strokes of the scalpel suffice to sever it completely.

The trachea is now stitched to the skin by chromicized catgut or silkworm-gut sutures. The edges of the pharynx are inverted and stitched to one another and to the base of the tongue with 21-day catgut. A mattress suture is often advisable for the skin flaps which should be made to cover the raw surface of the anterior wall of the gullet as completely as possible, and finally the superficial tissues are united with silkworm-gut sutures.

Before finally closing the pharynx a feeding tube of about 9 or 10 millimeters in diameter is introduced through the nose and firmly secured with a chromicized catgut stitch to the posterior pharynx wall. A drainage tube is inserted into the pharynx and stitched to the side of the feeding tube so that the pharyngeal end of the drain tube lies parallel with the feeding tube. This ensures that the opening does not get choked by touching any part of the mucous membrane at a right angle. When it is desired to remove the drainage tube the stitch which binds it to the feeding tube can be severed by slipping a well-fitting metal ring with a sharpened edge over the drain tube and running it up to the stitch. Two or three rotations of the ring will then cut through the stitch without the possibility of injuring any structure and when the stitch gives, drain tube and ring together with the handle by which the ring was introduced are all withdrawn together.

The dressings should be of the lightest character, bandages are unnecessary. A tracheotomy tube should be inserted and kept in until all tendency to crust formation at the tracheal opening has disappeared. If healing takes place with reasonable rapidity around the tracheal opening, there will be no tendency to contraction and the tube may be permanently dispensed with; but suppuration means the subsequent formation of cicatricial tissue which may tend to contract the aperture and necessitate the permanent wearing of a tube.

LARYNGECTOMY[1]

By GEORGE W. CRILE, M.D., F.A.C.S., Cleveland, Ohio

I WAS particularly interested in the way in which Sir Robert Woods has found he can train his patients to speak. A few of my patients have learned to speak of their own volition, but I have learned, what I consider of great importance, that I should turn these patients over to some one who knows how to teach them to speak.

I am entirely in accord with Sir Robert that there is a vast difference in operating on extrinsic and intrinsic carcinoma. In intrinsic carcinoma we have the one instance in which cancer is in a safety deposit box from which it cannot escape — except by growing upward into the hyoid space. The type of growth, therefore, determines at once the prognosis in operation upon these cases. The interior of the larynx has almost no lymphatic tissue, and intrinsic carcinoma does not require resection of the lymphatic glands, since penetration through hyaline cartilage does not occur. In extrinsic carcinoma, on the other hand, we are obliged to go far afield and resect all the lymphatics which bear upon the neck; otherwise we will have recurrences.

Another very important factor in prognosis is the presence of wound infection. I remember the disappointments in my early cases, in which the wound became seriously infected.

[1] Discussion of Sir Robert Woods' paper presented before Clinical Congress of American College of Surgeons, Philadelphia, October 24–28, 1921.

The tissues of the neck moved up and down as a pump, the patients inspired pus, and died of bronchopneumonia. I have had 41 total laryngectomies, and in the first cases I floundered badly. Since I adopted the technique that I shall describe in a moment, I have had 35 total laryngectomies. Of this number we lost two patients.

We divide the operation into two stages: at the first stage, under local anæsthesia or under analgesia with gas and oxygen, the larynx is exposed. We cut directly through the isthmus of the thyroid, turn the lobes of the thyroid to either side and expose completely the larynx and the upper part of the trachea. The thyroid gland is separated from the trachea and retracted. We then separate the trachea completely from the œsophagus and pack iodoform gauze behind the trachea and at the side of the larynx, right down to the carotid artery and the nerve. At the present time I do not open the trachea during the first stage, but at the beginning of the second stage. By putting iodoform gauze underneath the trachea and down toward the base of the neck the trachea becomes fixed, so that at the second stage of the operation, the mediastinum, which has no power of defense against infection, is entirely walled off by a big defense line made by iodoform gauze. Surgically speaking, we know if the mediastinum becomes infected there is little limitation of the infection, and the patient dies a slow death. In my first six cases I lost two from mediastinitis.

At the upper part of the trachea we always pack iodoform gauze deeply at one side of the larynx so that it comes in contact with the carotid artery and the vagus. Occasionally, following a laryngectomy, a local infection interferes with the innervation of both vagi at the same time. As a result the patient has a very rapid pulse, then a very slow pulse. If the vagus on one side is exposed during the first stage, it will recover from the irritation, and when laryngectomy is performed you will have one nerve that you can count on. One nerve will maintain function as well as two.

We have found it a very important matter so to operate that when the wound is closed there will be no tension whatever on the end of the trachea that is attached to the skin. Sometimes we leave the entire neck open following the laryngectomy, and perform a secondary suture later

I think that on the whole our patients run a very favorable course. We have realized, particularly during the past year, how difficult it is to manage the nutrition of the patient. In swallowing, the patient is apt to aspirate food into the trachea unless the trachea is attached to the skin. Of late, we have introduced, at the time of operation, an ordinary duodenal tube that passes through the stomach into the duodenum. It is possible to feed the patient entirely through such a tube, and to increase his weight during convalescence. One patient, during a convalescence of four months' duration, following removal of his tonsils and lymphatic glands, gained 51 pounds. During all that time he wore such a tube. We had to change it several times because the rubber became eroded, but nutrition was maintained splendidly.

My oldest patient has now been well 28 years since operation.

I believe there is no operation in surgery that offers so certain and permanent a cure from cancer as total laryngectomy in intrinsic cancer of the larynx.

STUDIES OF THE FUNCTION OF THE GALL BLADDER

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THE functions of virtually all of the organs of the human body have been rather definitely settled and in fact have been well known for many years. The notable exceptions to this statement are the glands of internal secretion and the gall bladder. In the case of the former some light has been shed by recent investigations, but in the latter case, even with our modern methods and facilities for investigation and experimentation, but little more is definitely known today than was known in the time of Oddi, he of ampulla of Vater sphincter fame. Nor is this condition due to a lack of earnest study, for the attention of some of the best known investigators both of the past and present has been drawn to this interesting and puzzling problem. The fact that modern methods have added so little to our knowledge of the functions of the gall bladder may be ascribed to the diversity of theories concerning these functions and to the flightiness of the investigators themselves. Instead of adhering strictly to one line of theory and investigation many of these men in their experimental work have attempted either to prove or disprove all of them and consequently have accomplished little.

As we have suggested, there is a great diversity of opinion regarding the part played by the gall bladder in the scheme of the human machine, varying from that held by Woods Hutchinson (1) and his followers, that the gall bladder is a vestigial organ and occupies a position parallel to that of the appendix, all the way to that of Kemp (2) who, in an article published in a London medical journal, in 1856, advanced the theory that the mucosa of the gall bladder acts as a catalytic agent which changes the bile in such a way as to make it of considerable importance to the organism.

As a striking illustration of the chaotic state of present-day information and theory concerning the function of the gall bladder, we will quote from two articles written by C. H. Mayo and W. J. Mayo respectively. Surely, if we are to find any semblance of agreement regarding the rôle of the gall bladder in the human machine we should expect to find it coming from these eminent surgeons who must draw their conclusions from observations on, statistics of, and experiments upon the same material. But read: "The gall bladder, in the human subject, when at rest, holds about an ounce of bile . . . Possibly an ounce of bile an hour is delivered. The gall-bladder in health is capable of expanding to contain several times its ordinary capacity without the consciousness of the person, unless there is obstruction causing cramping or spasm of its muscular structure or infection of its wall, in which case it can neither expand nor contract without the knowledge of its possessor. Man, being an omnivorous feeder, often eats such food as is slow of digestion or active in producing gas. A fair amount of distention of the duodenum by fluids in stasis or by gas would necessarily partially obstruct the common duct by flattening of that structure in the wall of the bowel, thus calling upon a reserve capacity which would distend the gall bladder until such a point as its muscular structure empties it against the duodenal pressure by rhythmic contractions, just as the ureter normally empties urine into either an empty or full bladder, in health a wholly automatic or unconscious action." (3).

W. J. Mayo: "What is the purpose of the gall bladder? In times past we have been ready to assert that it was a storehouse for bile, but there is as much bile secreted in twenty-four hours as there is urine; and of what avail would be a storage capacity of one ounce, which is the capacity of the normal gall bladder? If the conjecture that the gall bladder is a storehouse for bile were true, it should have some mechanism to force the bile out at proper intervals, but no one has

ever seen the gall bladder contract. The muscles in its walls are very scanty, not to be compared to the muscle in the wall of the stomach or urinary bladder." (4).

It will, perhaps, be advisable to consider briefly at this point the various theories of function of the gall bladder and to state a few of the facts in favor of and opposed to these theories.

By many men prominent in the medical profession, the gall bladder is considered as a vestigial organ, formerly of some importance but now of no use whatsoever in the scheme of things. Let us consider it from this standpoint.

It has been stated that no one has definitely proved a function for the gall bladder as it exists today. Assuming this to be true we must conclude either that our present methods of investigation and experimentation are inadequate to the task in hand, or that the gall bladder actually has no function. If the latter is correct, then we are forced to the conclusion that the gall bladder is a vestigial organ, since nature develops no useless structure and soon eliminates those organs whose function no longer exists. Furthermore, it has been pointed out that the gall bladder does not exist in all species of animals. Among others may be mentioned the horse, pocket-gopher, rhinoceros, rat, and deer, which possess no gall bladder. These animals, however, have considerably larger bile ducts than those possessing the viscus, so that the absence of this organ is to a certain extent compensated for. Even those animals which do possess a gall bladder seem to suffer no serious effects of removal of the organ. Human beings have been kept under observation for as long as 15 years following cholecystectomy, during which time they remained in apparently perfect health. (5).

On the other hand, we do not believe that proof of the existence of a function of the gall bladder is lacking and if it is a vestigial organ, of what is it a vestige and what was its former function? These questions have never been answered satisfactorily.

The gall bladder is formed very early in embryonic life, in fact even before the urinary bladder is formed; and while it is true that it does not exist in all species of animals, yet it is only very rarely absent in individuals of those species that do possess this organ. In the human only about 30 cases are on record of the complete absence of the gall bladder. In this respect it differs from the appendix, which is not infrequently absent. Furthermore, it is practically universally present in the carnivora, and absent only in a few species of herbivora. Again, if it is a vestigial organ, why should it be as well formed in man, who stands highest in the scale of evolution, as it is in the lowest vertebrate? It seems to us that such a theory is quite untenable and we believe that experimental evidence bears us out.

To the vast majority of medical men of the present day, the gall bladder is simply a reservoir for storing the surplus of bile. But is it? It has been estimated from observations made on biliary fistula cases that from 500 to 800 cubic centimeters of bile are secreted by the human being in 24 hours. This estimate is probably too conservative and many investigators now state that a quantity of bile equal to the average normal output of urine is secreted each day. This would mean a bile secretion of 900 to 1200 cubic centimeters in 24 hours. The bile is secreted by the liver continuously and at an approximately constant rate except during the period of digestion. Piersol (6) says the normal capacity of the gall bladder is approximately 50 cubic centimeters. It will thus be seen that about one hour's secretion of bile is sufficient to fill the viscus to its normal capacity. Therefore, the gall bladder is capable under normal conditions of holding only about 5 per cent of the 24 hours' supply of bile and perhaps usually contains only about 1 per cent of the daily output. C. H. Mayo (3) states that the gall bladder of a healthy individual is capable of expanding sufficiently to hold three or four times the usual amount without the person being in any way aware of it. We are unable to say on just what facts he bases his statement but possibly such a physiological expansion may occur. Certain it is, however, that the expanded gall bladders seen at autopsy or on the operating table were sufficiently diseased to cause very

marked symptoms. Granting, however, that the gall bladder can passively expand to three or four times its normal capacity, it is apparent that it would still be inadequate to hold all the bile secreted between meals.

If the gall bladder is a simple reservoir, it should be supplied with some mechanism by means of which it can empty itself of its contents. From the very nature of the organ and its location in the body such an intrinsic mechanism would necessarily have to be in the nature of a layer of muscle in the wall of the gall bladder. Such a layer actually exists but the muscle is so feeble as to be entirely inadequate to empty the viscus quickly. In fact, no one has ever found the normal gall bladder entirely empty, a condition that we should expect to find occasionally were the musculature adequate for the expulsion of its contents.

Sweet (7), on the other hand, believes that the gall bladder is emptied of its contents,—if, indeed, it is ever emptied, through the cystic duct,—by the pressure of the congested liver and the distended stomach during digestion and by the milking action of the peristaltic waves as they pass down the duodenum. As these waves progress, he believes, they act on the intramural portion of the common bile duct, just as the hand of the milk-maid acts on the teat in milking a cow. A slight negative pressure is thus set up in the common duct and the bile flows into the duodenum. The valve of Heister in the gall bladder is so constructed as to assist the entrance of bile into the viscus, but, once there, makes its withdrawal more difficult. He, therefore, concludes that the only logical explanation of the emptying of the gall bladder is by means of pressure from adjacent, distended, and congested, organs and by the milking action of the duodenal peristaltic waves.

In nearly all discussions concerning the function of the gall bladder, and especially as a simple reservoir, great stress is laid on the rhythmic contractions of the organ. In our quotation from C. H. Mayo (3) the reader will find that he states that the gall bladder will distend "until such a point as its muscular structure empties it against the duodenal pressure by rhythmic contractions." Since so much importance is laid on these rhythmic contractions let us consider them for a moment and determine their probable effect upon the emptying of the viscus.

Doyon (8) first reported, in 1893, the observation of spontaneous contractions of the gall bladder. Later Bainbridge and Dale (9) carried out a series of very complicated experiments from which they draw the following conclusions: (1) "The gall bladder shows rhythmic variation in volume; the rhythm is increased in extent after the removal of tonic inhibitory impulses either by section of the splanchnic nerves, or the intravenous injection of chrysotoxin. (2) The normal effect of stimulation of the sympathetic nerve supply to the muscular coat of the gall bladder, whether by electrical excitation of the right splanchnic nerve or by intravenous injection of adrenalin, is relaxation. (3) The vagus contains motor fibers for the gall bladder." Under the conditions of their experiments they found it impossible to elicit a reflex contraction of the gall bladder either by applying acid or the products of gastric digestion to the duodenal mucous membrane or to the biliary papilla, or by electrical excitation of the papilla, or by rapid distention of the gall bladder. They drew no conclusion, however, with regard to the existence of such reflexes in the unanæsthetized animal. Okada (10) with much simpler experiments found that "during digestion there is an increase in the force of the rhythmic contractions of the gall bladder." All of these observations were made merely to determine the existence or non-existence of such contractions, and it remained for J. A. Freese (11) of Johns Hopkins, to measure the actual force of the contractions. He found that "when stimulated through its motor nerves the gall bladder is capable of contracting against a pressure of at least 220 millimeters of Ringer's solution of a specific gravity of 1.004" but that "the maximum force of contraction exerted by the gall bladder does not exceed materially the maximum secretion pressure of the bile." The force of the contractions varied with the intracholecystic pressure as he showed by the following table:

Bladder under a pressure of	Rise	Total
305 mm.	7.0 mm.	312 mm.
305 mm.	8.0 mm.	313 mm.
190 mm.	26. mm.	216 mm.
197 mm.	21. mm.	218 mm.
200 mm.	14.5 mm.	214.5 mm.
217 mm.	4.0 mm.	221.0 mm.

Naunyn (12) found that in the dog the secretory pressure of the bile is approximately 300 millimeters of water, and if the pressure in the biliary passages is higher the liver cells secrete no more into the biliary passages, but the bile formed by them is taken up by the lymph vessels which surround them and is carried to the thoracic duct. Oddi (vid. 12) has determined the power with which the sphincter closes at 700 millimeters of water. With this in mind and recalling the fact that the maximum force of contraction of the gall bladder is only 313 millimeters of water, we can see at once that there must be a reciprocal innervation between the gall bladder and the sphincter of Oddi in order for us to assign any effect whatsoever to these contractions. Such a reciprocal innervation has never been demonstrated but is assumed by many prominent physiologists to exist. Certainly it is possible, but any further statement is mere conjecture.

Just what does all this mean? It means that the gall bladder undergoes rhythmic contractions at the rate of 5 to 8 per minute and that these contractions increase in force during digestion but that their maximum force does not materially exceed the maximum secretion pressure of the bile and hence have no more effect upon the emptying of the viscus than does the secretion pressure of the bile. These contractions are under the control of the nervous system and correspond exactly to the contractions of smooth muscle found in other parts of the body. Figure 1 shows a reproduction of one of Bainbridge and Dale's tracings of such contractions. At first sight one might think them of considerable extent but when one recalls the fact that the lever used in such work is of sufficient length to multiply the actual contraction wave as many as ten times, one gets the correct idea of their insignificant character. Smooth muscle wherever found undergoes slight rhythmic contractions, and those of the gall bladder are not greater and of no more importance and are entirely negligible so far as they effect the emptying of the viscus.

From the above facts the theory of the gall bladder acting as a simple reservoir for the surplus supply of bile seems inadequate and untenable.

Perhaps the next most generally accepted theory of the function of the gall bladder is that of a regulator of the flow of bile, but there seems to be but little more basis for this theory than for the previous ones. All animals that have been studied up to the present time, regardless of the presence or absence of a gall bladder in that particular species, have been found to have a definite sphincter muscle at the ampulla of Vater. These sphincters have been found to be essentially the same from a histological standpoint in animals without a gall bladder as in those with one. They do, however, differ in strength as has been shown by the work of F. C. Mann (13).

This investigator found that the sphincters of animals with a gall bladder withstand a pressure of 100 millimeters of water, whereas the sphincters of animals without this organ withstand only 30 millimeters of water pressure. He further determined that the secretory pressure of the bile in the liver of animals without a gall bladder is about the same as that of animals with this viscus-being in the dog approximately 300 milli, meters of water, in the rabbit 250 millimeters, the guinea pig 202 millimeters, and the rat 177 millimeters. Hence, the secretory pressure of the liver, being the same in both classes of animals, may be disregarded as a factor in the difference in the flow of bile. It is true that the bile is discharged into the intestines intermittently in animals possessing a gall bladder and continuously in those without the organ, but is it not more logical to assign this difference to the strength of the sphincter in those animals with a gall-bladder rather than to the presence of the gall bladder itself? Rost's experiments seem to bear out this contention (14). He found that after cholecystectomy, dogs may be divided into two groups. One group with well-developed sphincter

muscles continued to discharge bile into the duodenum intermittently until the common duct and ampulla became so widely dilated as to paralyze the muscle of Oddi. In the other groups with poorly developed sphincter muscles, the bile was discharged continuously and there was no dilatation of the ducts. It seems logical to conclude, therefore, that the flow of bile into the intestine is regulated by the muscle of Oddi rather than by the presence or absence of the gall bladder.

Another function ascribed to the gall bladder by some investigators is that of a regulator of pressure between the liver and the pancreas. The secretions of these two organs are emptied into the ampulla of Vater which has been likened to a carburetor or a mixing chamber (4). Neither the common duct nor the pancreatic duct is guarded by a valve, and it is pointed out that if it were not for the presence of the gall bladder, bile would be forced up the pancreatic duct into the pancreas and set up a severe or even fatal pancreatitis in those cases in which there is some obstruction to the flow of bile into the intestine. We are unable to follow this line of reasoning because the pressure of the bile in the gall bladder, the common duct, and the hepatic duct, must be approximately equal according to the law of physics that pressure exerted by a fluid is equal in all directions, and the pressure against the mouth of the pancreatic duct must also be the same since it is part of the same system. Now the pancreas secretes pancreatic juice only intermittently and chiefly during digestion, at which time the bile is being poured into the intestine. During its periods of inactivity the pressure in the pancreatic duct is zero. Hence by all the laws of physics bile should be forced from the area of high pressure in the gall bladder and ducts into the area of zero pressure in the pancreatic duct. The gall bladder is capable of only passive expansion and hence can play no part in preventing this. This statement is borne out by the fact that such a condition occurs no more frequently following cholecystectomy than before such an operation. The whole theory falls flat when we recall that in only about 35 per cent of all cases is the arrangement of the

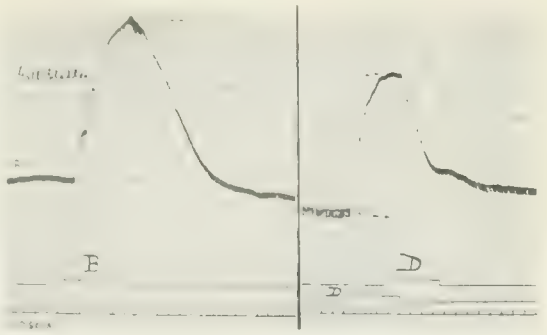

Fig. 1. Contractions of the gall bladder. (From Bainbridge and Dale.)

pancreatic ducts and bile ducts such as to make regurgitation of bile into the pancreas possible (15). The arrangement of the ducts in the other 65 per cent of cases and the embryological development of the pancreas which explains such arrangements are shown in Figures 2 and 3.

The next theory, and one which is not being generally accepted, is that the gall bladder is an actively secreting organ, elaborating and adding to the bile something which is of importance either to the general body economy or to the mechanism of bile expulsion or its chemical action. It is undoubtedly true that the bile of the gall bladder is different from that coming from the liver. The cystic bile is six to ten times as rich in solids as the hepatic bile. Forty cubic centimeters of cystic bile is consequently equivalent to 240 to 400 cubic centimeters of hepatic bile. During the period that the bile remains in the gall bladder, it undergoes certain changes as can be seen by the following table taken from Starling's *Physiology* (16).

Analyses of Bile (Human)

From a biliary fistula (Yeo and Herroun) in 100 parts		From the g.b. (Hoppe-Seyler) in 100 parts	
Mucin and pigments	0.148	Mucin	1.29
Sodium taurocholate	0.055	Sodium taurocholate	0.87
Sodium glycocholate	0.105	Sodium glycocholate	3.03
Cholesterin		Soaps	1.39
Lecithin	0.038	Cholesterin	0.35
Fats		Lecithin	0.53
Inorganic salts	0.840	Fats	0.73
Water	98.7		

It will be seen from the above that as far as constituents are concerned, the difference between cystic and hepatic bile is chiefly due

Fig. 2. Reconstruction of the two pancreas anlagen in a human embryo of 5 weeks. *Ch*, ductus choledochus; *v*, ventral anlage; *dr*, dorsal anlage; *s*, stomach. (From Hamburger.)

to the presence in the former of more mucin, sodium taurocholate, sodium glycocholate, and cholesterin. So far as is definitely known, the gall bladder adds no new constituent. However, as early as 1856, Kemp of London, stated "that the mucus of the gall bladder is not merely a secretion designed to lubricate the interior of that organ and protect it from irritation of its other contents, but is an essential and integral portion of the cystic bile." On the basis of the rapid crystallization of honey solutions containing pieces of washed gall bladder mucosa he stated that "the mucus lining of the gall bladder acts as a catalytic body capable of producing molecular changes in the bile." Leede (17) of our own country has stated that the gall bladder probably secretes a hormone which stimulates the flow of bile and pancreatic juice but he offers no very convincing proof of his statement. It is more probable that secretin, the pancreatic hormone, also stimulates the flow of bile, as will be referred to again. All in all, the theory that the gall bladder is an actively secreting organ does not seem to be well founded but that the bile is changed, at least by concentration by the gall bladder, there can be no doubt; that the severe and often fatal pancreatitis set up by artificial injection of hepatic bile into the pancreas (18) and the very slight effect of a similar injection of cystic bile points to any other change in cystic bile than concentration, is not clear.

The last of the common theories of the function of the gall bladder is that of a concentrating organ. Of this function there can no longer be any doubt. Rous and McMaster (19) of the Rockefeller Institute "have noted the fact that the fluid which collects in bile ducts experimentally obstructed is an inspissated, tarry bile when the ducts communicate with the gall bladder, whereas in ducts unconnected with the viscus the fluid is thin and soon becomes free from pigment and cholates. It has long been recognized that the gall bladder must have a concentrating function since bladder bile is more concentrated than duct bile from the same animal; and continued functioning during stasis will explain the tarry bile then found. The inspissation occurs so rapidly as to raise the question whether concentration of the bile in periods of intermittent or partial stasis may not be an important favoring element in the formation of gall stones." They took advantage of the arrangement of the hepatic ducts of the dog to determine the rate of concentration. There are three of these ducts, which unite to form a common duct, with the cystic emptying high up in the central one. The middle one was ligated and the bile from the middle lobes of the liver had no way of escaping save into the gall bladder. That from the lobes to either side still reached the common duct from which it was collected into a rubber balloon placed in the peritoneal cavity. After 24 hours the gall bladder, still undistended, was regularly found to contain only one-sixth to one-tenth as much fluid as should on calculation have reached it, but this, thick and dark, was six to ten times as concentrated in pigment as the control specimen in the rubber balloon."

All in all, with the exception of this last, the theories of the function of the gall bladder so far advanced are not very satisfactory and one is almost tempted to accept the viewpoint of Woods Hutchinson (1) and others that it is merely a vestigial structure whose prehistoric function has not been discovered. The prevalence of this theory was well illustrated to H. S. Noble (20) who sent out 50 letters, 25 to surgeons and 25 to internists asking their opinion of the usefulness of the gall bladder and choice of cholecystectomy or cholecystostomy. Seventeen of the 25 surgeons believed the gall bladder to be a vestigial or functionless organ; 6 thought it possibly had a function—while 2 made no reply to the question. The surprising thing, however, was the blood-thirsty reply of the internists, for

among their replies, 19 were found who believed that the gall bladder is a vestigial organ and should be removed whenever diseased to an extent requiring surgery. The remaining 6 were not so sure of the unimportance of the gall bladder and advised its removal only when hopelessly destroyed by disease. The changes following cholecystectomy show that the gall bladder does have some function for the loss of which nature is trying to compensate.

Judd and Mann (21) found that after removal of the gall bladder all of the ducts outside the liver dilate and that the chief factor in producing this dilatation is the sphincter at the entrance of the common bile duct. After cholecystectomy this sphincter can withstand only a small percentage of the pressure which it normally maintains. When all the muscle fibers are dissected free from the intramural portion of the duct, the biliary tract does not dilate after removal of the gall bladder. Rost (14) showed that in dogs in which the sphincter muscle was poorly developed there was incontinence of bile and no dilatation of the ducts following cholecystectomy. This dilatation of the extrahepatic ducts following cholecystectomy seems to be in the nature of an attempt to compensate for the loss of function of the gall bladder. In another group of experiments by Rost (14), which were designed to show whether the injection of a certain amount of food which had been predigested by another dog would produce the same amount of bile and pancreatic juice in a cholecystectomized animal as in an animal with a gall bladder, it was found that the dog without the gall bladder secreted very much less bile and pancreatic juice than the dog with the gall bladder, the proportion being as 50 to 150. From control experiments he concluded that this is to be explained by an "increased exhaustibility" of secretin.

It has been stated that changes in the acidity of the gastric secretion occur following cholecystectomy. Hohlweg (22), in a study of 42 patients after cholecystectomy found that 69 per cent showed hydrochloric acid deficit, 14.3 per cent had free hydrochloric acid under 20 and only 16.6 per cent had normal gastric acidity. In 43 cases of closure of the cystic duct with marked shrinking of the gall bladder, 84 per cent showed hydrochloric acid deficit, 6 cases showed free hydrochloric acid of less than 20 and only one case was normal. Fenger (23), on the other hand, in a study of 75 patients before and after cholecystectomy, found that there was no influence on the gastric secretion from removal of the gall bladder, any more than from cholelithiasis in general.

Fig. 3. The four types of anastomosis between ductus choledochus and duct of Wirsung, seen in cross section of the duodenal wall. (From Letulle and Nattan-Larrier.)

In our own experiments on the function of the gall bladder, we started out with the idea that if the function of the gall bladder is to pour something into the channels of the driving mechanism, whether it be in the nature of an internal secretion, hormone, or other substance, it could just as well perform this duty during continuous as during intermittent drainage, and changes would not necessarily be expected, either in the gall bladder or its ducts. A simple and plausible method of effecting this drainage suggested itself in the form of cholecystogastrostomy, or anastomosis between the gall bladder and the stomach. This was done in a series of 15 dogs. In some cases the common duct was tied and in others it was not molested. The outstanding results of the experiments were that the gall bladder decreased in size, and

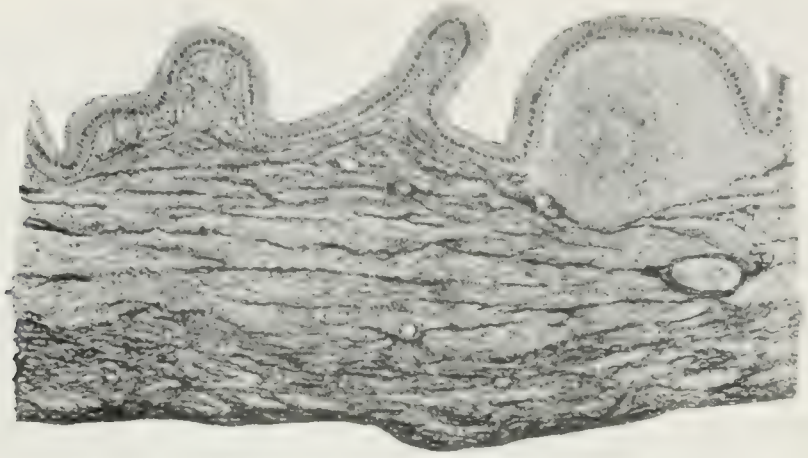

Fig. 4. Section through the contracted gall bladder of a dog, magnified eighty times, showing the arrangement into coats and the relations of the blood vessels. (From Sudler.)

in those cases in which the common duct had been ligated the ducts dilated.

How are we to account for such changes? Is the dilatation of the ducts due to gastric pressure and the forcing out of stomach contents, or has the permanent drainage interfered with the normal function of the gall bladder and nature in her endeavor to carry on this function through the normal channels caused the ducts to hypertrophy? We found no conclusive evidence of regurgitated materials in the biliary passages, and roentgenological studies of patients after cholecystogastrostomy, according to reported studies by Babcock (24) and according to one case in the X-ray department of the Hospital of the University of Pennsylvania, fail to show regurgitation of stomach contents after bismuth meals. Furthermore, if the dilatation of the ducts were due to gastric pressure the gall bladder would be first affected and we would expect it to be increased in size rather than decreased. It is an established fact that when the function of any organ is interrupted it atrophies. It seems logical to assume, then, that the constant drainage has placed the gall bladder in a position unfavorable for the performance of its normal function and it has, therefore, undergone atrophy.

We agree with W. J. Mayo that the gall bladder cannot act as a simple reservoir but we do not agree with his statement that "the gall bladder has no lymphatic glands and very few lymphatic channels; therefore, it has not the possibility of ready absorption." (4). In fact we have been impressed throughout the entire work with the size and number of lymphatics on the surface of the gall bladder, and equally so by the amount of flow observed after inserting capillary tubes into the lymph vessels leading from the gall bladder.

Since we believe the lymphatics of the gall bladder to be so important, it seems advisable at this point to consider briefly their development and the anatomy and histology of the gall bladder.

The significance and importance of the lymphatics have long been recognized (25). Aristotle (384-322 B. C.) as is evident from a phrase in *History of Animals* appears to have seen lymphatic vessels; but it is to Herophilus (300 B. C.) and to Herasistratus (280 B. C.) to whom we ought, according to the Galenic writings, to attribute the discovery of the chyliferous vessels. Herasistratus saw their milky contents; Herophilus their termination in the mesenteric glands. The former regarded them as arteries, the latter as veins. These observations, which were denied by Galen, were forgotten and it was only in 1532 that Nicholas Massa apparently discovered some renal lymphatics. Then Fallopius discovered some white vessels which terminated in the peripancreatic glands, never realizing that

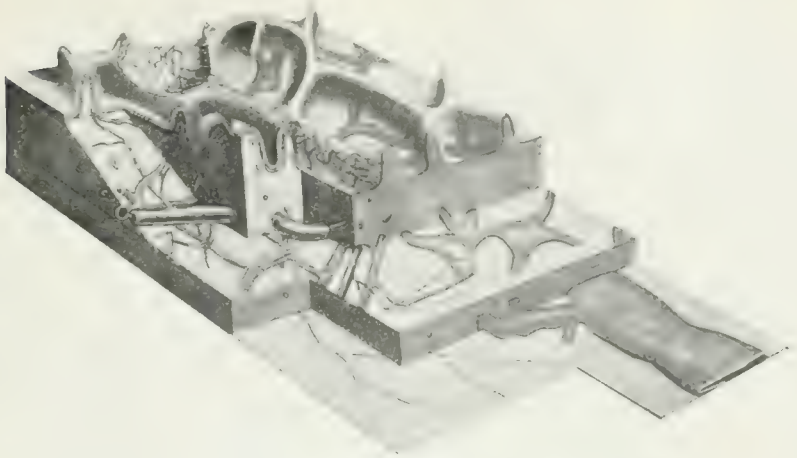

Fig. 5. Reconstruction of the wall of the partially contracted gall bladder of a dog, magnified sixty times, showing the blood vessels on the left and the lymphatics on the right. Lymph follicles are shown on the left as two rounded eminences just under the epithelium. The vena comites shown is quite characteristic for the larger arteries. The large lymphatic vessel is shown partially collapsed. (Modified from Sudler.)

they formed such an important link in the transmission of upper abdominal infections.

The working out of the development of the lymphatic system has been as long as it is complicated and it remained for Sabin (26), following in the footsteps of Budge (27) and Ranvier (28), to supply the missing link in the work. She has shown that the lymphatic system in the embryo pig begins as two blind ducts which bud off from the veins in the neck; at the very beginning the openings of these ducts into the veins are guarded by valves formed by the direction which the endothelial bud takes as it grows from the veins. In the ducts themselves there are no valves at first. From these two buds and later from two similar buds in the inguinal region, ducts grow toward the skin and widen out to form four sacs or lymph hearts and from these sacs the lymphatics grow to the skin and cover its surface. At the same time there is a growth of ducts along the dorsal line following the aorta to make a thoracic duct from which the lymphatics grow to the various organs. Thus the ducts of the lymphatic system gradually invade the body, but there are certain tissues which they never reach, even in the adult, i.e., cornea and cartilage (Sabin). The lymphatic system is a modification of the circulatory system, dependent both in its origin and, in a large measure, in its development, on the blood vessels. It returns to the vascular system the fluid exuded into the tissue spaces from the blood vessels. Speaking more generally, it is a system of absorbents. The lymph glands do not begin to develop in mammalian embryos until the ducts or capillaries they drain are well formed. The lymphatic system is a closed system and the lymph radicles are the tissue spaces. The terminal lymphatics bear the same relationship to the tissue spaces as do the capillaries. This relationship might be compared to a bath sponge saturated in tissue fluid, into whose interstices are introduced two test tubes whose walls are permeable, one containing blood and the other lymph. In the capillaries there is serum, in the tissue spaces, tissue fluid, and in the lymphatics, lymph, all different in composition and having a free but selective interchange of products.

Huntington (29) and his followers believe, however, that the lymphatics are developed primarily from the intercellular mesodermal spaces and later attain their entrance into the venous system through the intervention of the jugular lymph sacs.

The gall bladder, of entodermal origin (3), is developed from the distal portion of the hepatic diverticulum. This diverticulum very

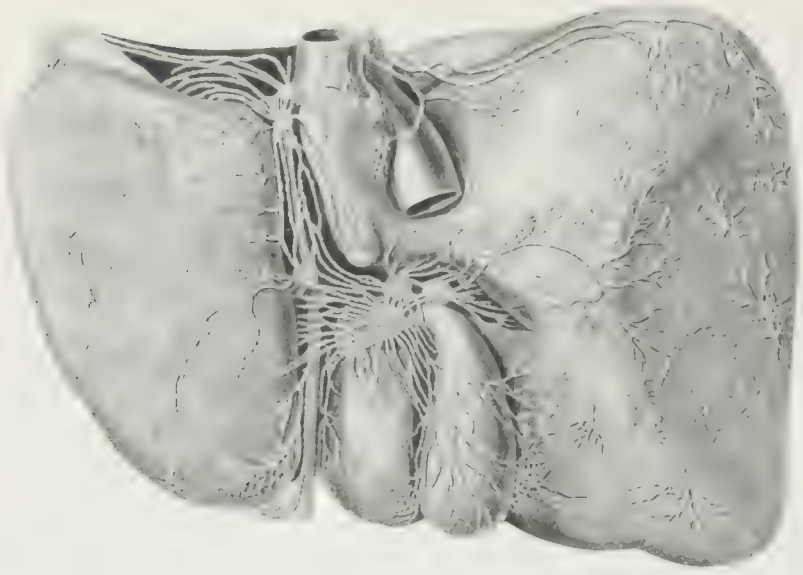

Fig. 6. Lymphatics of the liver and gall bladder, posterior view. (Modified from Sappey.)

early shows a terminal rounded subdivision and elongation which gives rise to the gall bladder and cystic duct, at first as a solid outgrowth but later becoming patulous, the lumen developing from the duct side.

At 7.5 millimeters the epithelium is surrounded by a layer of mesenchyma and the entire structure is so imbedded in the under surface of the liver that it causes only a slight swelling of the peritoneal surface. Above and on the sides, the mesenchyma is in direct relation with the hepatic trabeculæ, and it receives a few prolongations of the venous capillaries. Below it is covered by the peritoneal epithelium except on the left where that layer is reflected to the abdominal wall in connection with the falciform ligament. In the later stages, the gall bladder is separated from the hepatic trabeculæ on either side and is attached to the liver along its upper surface.

At 22.8 millimeters the mesenchyma surrounding the gall bladder forms two broad concentric zones of which the inner is darker and more compact than the outer. At 29 millimeters certain cells in the peripheral part of the dark zone form a third layer, which is thin and somewhat interrupted. As seen in later stages these cells are myoblasts, so that at this early stage the three principal layers are clearly indicated.

At the 10 millimeter stage the hepatic artery can be followed to the hepatic duct and a little later it extends along the hepatic and cystic ducts, but as the cystic branches develop first, the hepatic artery appears primarily as the artery of the gall bladder.

Three stages may be recognized in the development of the blood vessels of the gall bladder (30). In the first, the capillaries from the portal network extend into the mesenchyma around the gall bladder, in the second, they are joined by the arterial capillaries and become efferent vessels; in the third, a single efferent vein, extending along the cystic duct and emptying into the portal trunk, is developed from the capillary system.

The nerve supply (31) of the gall bladder has been studied by Dogiel (32) and Huber (33) within recent years. The nerve supply is derived from two sources; (1) the sympathetic system of ganglia and fibers connecting them; (2) medullated fibers accompanying large arteries. In regard to the distribution of the sympathetic fibers, Huber suggests from the condition prevailing in other viscera that they supply the blood vessels and smooth muscle of the coat.

Fig. 7.

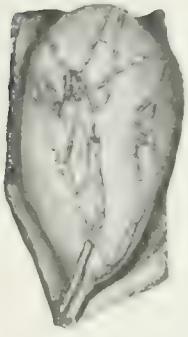

Fig. 8.

Fig. 9.

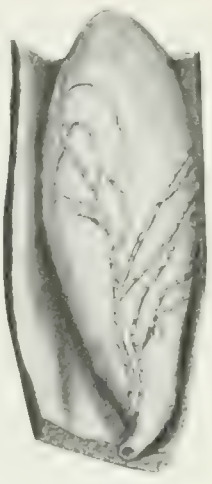

Fig. 10.

Fig. 7. Gall bladder of a pig. The lymphatics were injected by placing the needle just under the peritoneal covering of the liver near the edge of the gall bladder. The blurred mass in the center represents the injection mass showing through and the lymphatics coming up from deeper layer to join the large superficial one. (From Sudler.)

Fig. 8. Gall bladder of adult man, showing superficial lymphatics. (From Sudler.)

Fig. 9. Gall bladder of man 19 years old, dead of chronic nephritis, showing the large superficial lymphatics. This gall bladder gave evidence of having been through an inflammatory process, and so the lymphatics are probably abnormally numerous. (From Sudler.)

Fig. 10. Gall bladder of a dog, showing the superficial lymphatic vessels. (From Sudler.)

Doyon (34) thinks these are unable to act without receiving stimuli from the great splanchnic nerve. Dogiel believes that all varieties found in the wall of the intestine are found here.

The architecture of the gall bladder has been very clearly presented by Sudler (31). The thickness of the wall in the human adult is from ¾ millimeter in state of distention to 2 millimeters in state of contraction. The wall is composed of the following layers: (1) mucous; (2) fibromuscular; (3) subserous, and on the free part covered by peritoneum; (4) serous.

The mucous layer is thrown into a series of folds which cover corresponding ridges of connective tissue of the fibromuscular layer and contain an exceptionally rich capillary network. In the crypts formed by the folds, solitary lymph follicles are found. The mucous layer is composed of simple columnar epithelium which rests upon an incomplete muscularis mucosa.

The fibromuscular coat is composed of smooth muscle fibers and interlacing bands of connective tissue. Hendrickson (35) has concluded and is supported by Sudler and others, that there are no definite layers and that the fibers interlace in all directions with the greatest number tending toward a transverse direction, as is shown in Figure 4. The part of this layer near the mucous membrane is composed almost entirely of connective tissue with only a few muscle fibers scattered through it, the part directly under the ephithelium forming a mucosa, which, however, shades off gradually and is not sharply separated from the underlying tissue.

It is in this region of the fibromuscular layer that the thickest plexus of capillaries and intrinsic lymph channels exists. The solitary lymph follicles, to which reference has already been made, are found also under the mucous membrane as shown in Figure 5.

Sudler says that if the needle of a hypodermic syringe be introduced into one of the smaller arteries and the mucous surface be watched while fluid is slowly injected, the arterioles and capillaries can be seen to be filled in areas about 2½ millimeters in diameter at a time from a single centrally placed

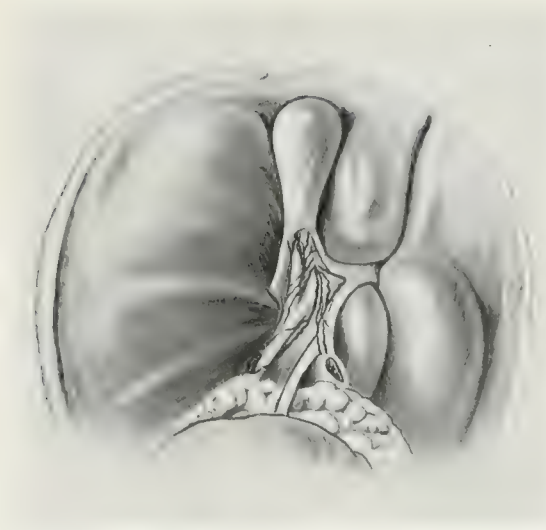

Fig. 11. The relation of the lymphatics of the gall bladder to the head of the pancreas. (From Franke.)

artery. The blood from these is collected into accompanying veins.

There are many lymphatic vessels running over the surface of the gall bladder, some carrying lymph from the liver, but most from the layers of the gall bladder. In the dog, they follow the inner side of the cystic duct and end in lymph glands lying near the head of the pancreas. In man, we have either one or two systems of large lymph vessels, and in almost all cases both systems are represented, but the territory drained by them may not be equally large, and there is wide variation in their method of distribution.

In cross section these vessels are always flattened though the degree of flattening varies with the completeness of the injection. They run down on the inner side of the gall bladder and usually there is a large vessel coming from the same side. In the subserous layer there is a network of lymph channels which empty into these larger vessels. Sappey (45) too, shows a mass of them running over the gall bladder, as shown in Figure 6, and mentions the fact that they bring lymph from the liver and deeper layers of the gall bladder.

Impressed from the first with the rich lymphatic supply of the gall bladder and believing firmly in their importance in connection with the function of this organ, we next asked ourselves what would be the effect of removing the lymphatic glands that drain this area. In a series of six animals these glands were removed. In all cases the lymphatic vessels leading to the extirpated glands were found to be dilated, in one case to six to eight times the normal size. We believe this dilatation was due to the blocking of the lymphatic channels caused by the removal of the glands which normally drain them, and to the backing up in these blocked channels of lymph from the gall bladder. The extent of the dilatation of these vessels is significant, because it shows the great amount of drainage from the gall bladder by way of the lymphatic system. This method provided a sort of "natural injection" of the lymphatics of the gall bladder which, in the dog, has not been very satisfactorily done artificially.

The very great concentration of the bile in the gall bladder must be explained in some way. So far as we know there are but two possible agencies by which this concentration could be affected, viz: the venous and the lymphatic systems. Mall (48) has shown that a considerable amount of fluid can be taken up by the venous system, and undoubtedly the veins of the gall bladder play some part in removing the excess water from the bile, but the gall bladder wall is not especially rich in veins and hence too much importance cannot be logically assigned to them as dehydrators of the bile. On the other hand, the lymphatic system is especially adapted to such a rôle and as we have shown before is extensively developed in the wall of the gall bladder. Furthermore, the marked dilatation of the vessels following removal of the glands and the very free flow of lymph in capillary tubes inserted into the lymphatics on the surface of the gall bladder show the free drainage of the viscus through these channels. What, then, would be more reasonable to conclude than that the concentration of the bile is effected chiefly by the lymphatics, and if such is true would we not expect to recover from the lymphatics solutions injected into the gall bladder?

In a series of normal dogs the duodenum was opened and an ureteral catheter intro-

duced through the ampulla of Vater, up the ducts and into the gall bladder, which was drained and washed out with normal salt solution. A hypertonic solution of potassium sulpho-cyanide was introduced slowly until the gall bladder had been distended to the same degree as before, and the catheter was left in place. Lymph was collected in capillary tubes from the lymph channels and tested with ferric chloride. Within a very short time after injection, positive tests were obtained. In fact, working as rapidly as possible, the very first specimen obtained gave a positive result. Furthermore, bits of the glands at distant points draining this area, also gave a positive test. In each dog the result was the same, which seems to show undoubtedly, the direct pathway through which the fluid is given off in the process of concentration of the bile. It should be noted here that in such experiments as the above only those solutions can be used which will not react with the bile in such a way as to block the lymph channels. Thus ferric chloride reacts with the bile by forming a thick coagulum which completely blocks the lymph channels and makes its recovery impossible.

This dehydrating action of the lymphatics of the gall bladder we believe to be important in infections of the organ itself and of the pancreas as well. The source of infections of the gall bladder has long been a mooted question. By some it has been considered blood-borne, by others duct-borne, and by still others of biliary origin. It is our belief that the lymphatics are the chief connecting links between the members of the evil triumvirate of the abdomen, the appendix, gall bladder and pancreas. Infection starting in the appendix is carried by way of the portal system to the liver. This organ, as has been shown by Adami (49) and others, (50, 51 and 52) acts as a filter to remove and destroy bacteria carried to it from other structures, but when bacteria reach it in sufficiently large numbers, it fails to act completely and at first attenuated, but living, organisms and finally fully virulent organisms enter the bile and are carried to the gall bladder. C. H. Mayo emphasizes the fact that the mucous membrane of the gall bladder is very resistant to infection (5); so it is, but we believe that after bacteria gain entrance to the gall bladder through the bile they filter into the lymphatics of the fibromuscular layer and there set up inflammation causing a cholecystitis. In the same way bacteria are carried from the wall of the gall bladder by way of the lymphatics to the glands around the head of the pancreas where they set up a lymphangitis and lymphadenitis. This causes a blockage of the lymph drainage of the pancreas and a lymph stasis which later becomes organized and results in chronic pancreatitis. This explains why the pancreas is so frequently sterile when the seat of chronic pancreatitis, a fact that has not been satisfactorily accounted for by the proponents of the theory of duct-borne infections of this organ.

CONCLUSIONS

1. That the function of the gall bladder is that of a concentrator of bile, which concentration is effected chiefly by the lymphatics.

2. That the gall bladder is emptied of its contents,—if it is emptied at all through the cystic duct,—by pressure of adjacent, distended and congested, organs during digestion, and by the milking action of the duodenal peristaltic waves, and that the rhythmic contractions of the gall bladder are of no importance in this respect.

3. That by means of the lymphatics infections are carried from the gall bladder to the glands at the head of the pancreas, producing a lymphangitis and lymphadenitis and a lymph stasis which later becomes organized and results in chronic pancreatitis.

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SARCOMA OF THE LONG BONES

A Study of Microscopically Proved Cases[1]

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THE successful treatment of sarcoma of the long bones depends on the early recognition and eradication of the growth and on the prevention of metastasis. The successful removal of sarcoma by local excision or by amputation has been repeatedly demonstrated. Pulmonary metastasis through the blood stream is the most common complication; however, this may not occur for years, the patient meanwhile remaining in good health. The roentgenogram affords our earliest means of diagnosis of metastasis, but, unfortunately, when metastasis has occurred the prognosis is hopeless.

That the problem of sarcoma of the long bones has not been solved, is obvious from the reports in the literature. Increasing percentages of 5-year cures are being reported in cases of carcinoma, the result of emphasis placed on early diagnosis, radical surgery, and preventive therapeutic measures, but reports of cures following the treatment of sarcoma remain most discouraging.

Future methods of treating sarcoma of the long bones may best be judged in relation to past methods and results. At a symposium on sarcoma of the long bones given before the Royal Society of Medicine in London in 1912, St. Bartholomew's Hospital reported 61 cases with 3 3-year cures, and St. Thomas' Hospital reported 45 cases, with 5 3-year cures in cases of sarcoma of the giant-cell type. Escher, in 1920, reported from the University of Vienna 40 cases, with 6 patients living more than 2 years; Bloodgood, in 1920, reported 89 cases, with 4 patients living 5 years; Coley, in 1919, reported 250 cases, with 31 patients living 3 years. In the Mayo Clinic from September, 1907, to September, 1921, 470 cases were diagnosed sarcoma of the extremities; 168 (35.7 per cent) of these were sarcoma of the long bones. One hundred nine of the patients were operated on and a microscopic diagnosis was made of sarcoma of the femur, tibia, fibula, humerus, radius, and ulna. Besides the 470 cases, there were 18 in which a diagnosis of giant-cell tumor of the long bones was made at operation and from microscopic examination; these cases have not been included in the study, as we considered them benign (Figs. 1, 2, 3 and 4).

All of the 109 patients were subjected to careful history taking and physical and roentgenographic examinations. Routine examinations were made to exclude syphilis. Esmarch's bandage was applied to prevent metastasis. The tumor was explored and a section examined microscopically before radical surgical measures were undertaken. Fifty-nine (35 per cent) of the 168 patients were inoperable at the time of examination or they refused operation. Usually a consultation was held of two other surgeons and the examining physician before amputation or operation was decided on. In studying the cases, if any doubt existed with regard to the previous interpretation, the material in the pathological museum was again examined microscopically by the consulting pathologist.

In 85 of the 109 cases the sarcoma was in a lower extremity. It was in the femur in 49; in the tibia in 27; in the fibula in 9; in the humerus in 18; in the radius in 3; and in the ulna in 3. The left lower femur was involved in 27, the right in 22, the upper end of the left tibia in 17, and the right in 10. Figure 5 shows the distribution, location, and type of the tumor (Table 1).

The average age of the patients in the series was 26.7 years. Sixty-nine were males and forty were females. Twenty-seven of the males were more than 30 years; the oldest was 69 years and the youngest 9. Thirteen of the females were more than 30 years; the oldest was 67 years and the youngest 4. In 82 (75.2 per cent) the common age of occurrence was between 10 and 40 years.

[1]Presented before the Clinical Congress of American College of Surgeons, Philadelphia, October 25, 1921.

Fig. 1. Foreign body giant-cell tumor.

Fig. 2. After excision and autogenous bone graft.

It is important to obtain a careful history with regard to pain, rapidity of the growth of the tumor, duration of symptoms, type of trauma, syphilis, disease of the bones, fractures, and previous treatment. The clinical history plays an important part in the differential diagnosis. Family history showed tuberculosis in 9 of our cases and cancer in 7. The factor of occupation as an aid in diagnosis is illustrated by the following case.

Case 1. (A81308.) A horseshoer came to the Clinic for advice March 2, 1913, concerning amputation for supposed sarcoma of the left femur. He had had pain for 18 months, and a roentgenographic examination had been made and sarcoma diagnosed. Our roentgenograms showed periosteal thickening of the femur at the point where the horse's hoof usually rested and from the clinical examination we were of the opinion it was a benign swelling due to occupational trauma. The femur was explored and no evidence of malignancy found. The patient was advised to give up his work and report later for examination. No sign of growth has appeared since then; it undoubtedly is a case of traumatic periosteitis.

TABLE I.—SARCOMA OF EXTREMITIES

470 Cases—September, 1907 to September, 1921

	Cases
Long bones (upper 33; lower 135)	168
Long bones operated on (upper 24; lower 85)	109
Long bones not operated on (upper 9; lower 50)	59
Small bones and soft tissue	302
Small bones and soft tissue operated on (upper 42; lower 113)	155
Small bones and soft tissue not operated on (upper 56; lower 91)	147

Eighteen cases of giant-cell tumors of the long bones are not included since all the patients are living and the condition is considered benign.

Trauma has been considered the cause of sarcoma of the bone; Gross gave it as a cause in 50 per cent of his cases and Escher in 39 per cent. In our series, 58 patients (53.2 per cent) gave a positive history of trauma. The type of injury is significant. My experience leads me to believe that the single, hard, local injury is the type most often followed by sarcoma. Constant irritation causes traumatic periosteitis; a more severe injury often causes a subperiosteal hæmatoma which may undergo ossification rather than absorption. In Case 2 the patient gave a history of a severe local injury several weeks before the fracture occurred from a slight strain; this should have been suggestive of a pathological fracture. Bissell has suggested the possibility of sarcoma following fracture; he reported it in six

TABLE II.—SARCOMA OF THE LONG BONES

Relation of trauma to the type of cell found—109 cases

Type	Patients	Patients with trauma
Mixed-cell sarcoma	52	29 (55.76 per cent)
Round-cell sarcoma	14	10 (71.42 per cent)
Osteosarcoma	18	7 (38.8 per cent)
Chondrosarcoma	17	7 (41.17 per cent)
Fibrosarcoma	8	4 (50.0 per cent)

TABLE III.—SARCOMA OF THE LONG BONES

Relation of type of cell to age—109 cases

Type	Patients	Average age (years)
Mixed-cell sarcoma	52	24.73
Round-cell sarcoma	14	25.85
Osteosarcoma	18	25.4
Chondrosarcoma	17	27.64
Fibrosarcoma	8	38.37

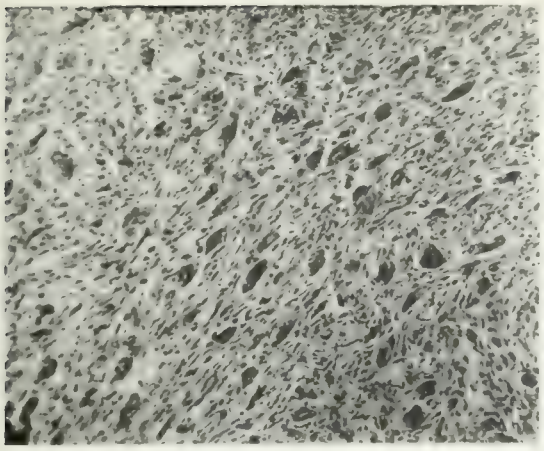


Fig. 3. Typical giant-cell tumor containing numerous foreign body giant cells. X100.

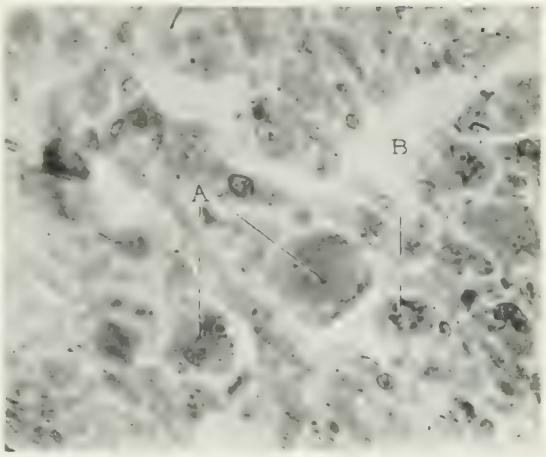


Fig. 4. Medullary sarcoma of tibia containing tumor giant cells. *a*, Tumor giant cells; *b*, mitotic figure. X500.

cases. The significant relationship between trauma and sarcoma is further borne out by the localization of sarcoma in the parts most commonly exposed to trauma. In our series, 78 per cent of the tumors were in the long bones of the knee, and 75 per cent occurred between the ages of 10 and 40 years, the time when injury is most likely to occur. In the first decade the tumor was around the knee, the site of common injury in children. The relationship of the type of cell in cases in which the history of trauma is positive is shown in Table II and the relation of age to the type of cell is shown in Tables III and IV.

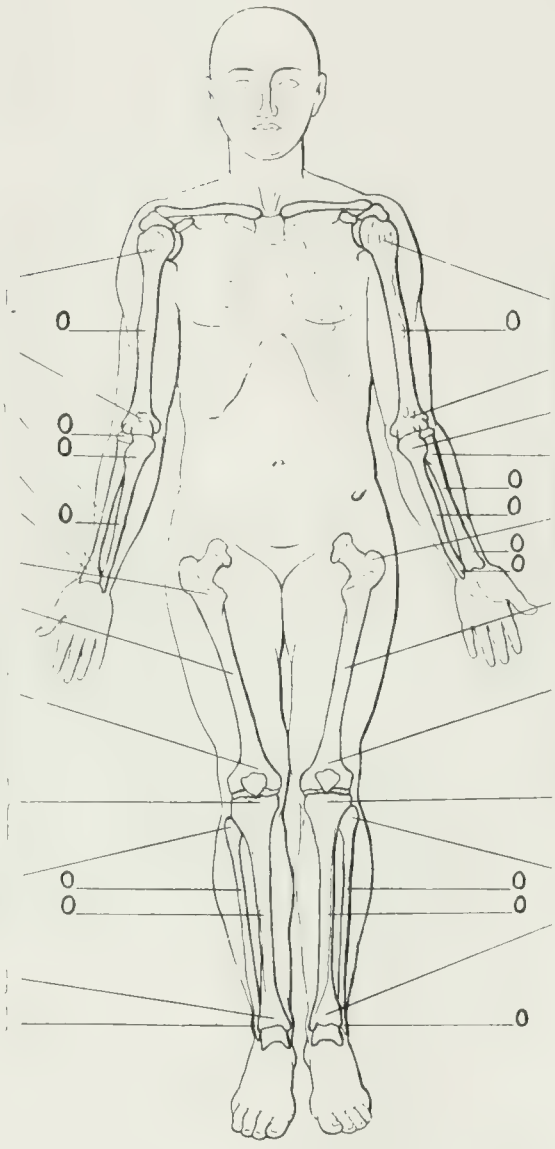
TABLE IV.—SARCOMA OF THE LONG BONES[1]
Relation of age to location 109 cases, September, 1907 to September, 1921

Patients	Bone		Years						Total
			1 to 10	11 to 20	21 to 30	31 to 40	41 to 50	More than 50	
49	Femur	Right	3	5	6	3	4	1	22
		Left	4	5	8	7	3		27
27	Tibia	Right	1	3	3	2		1	10
		Left		8	7	1	1		17
9	Fibula	Right	2			1	1	1	5
		Left		2	1	1			4
18	Humerus	Right		5	1		1	2	9
		Left		4	2	2		1	9
3	Radius	Right		1		1			2
		Left		1					1
3	Ulna	Right				1	1		2
		Left			1				1
109			10	33	29	19	11	6	129

[1] Diagnosis on operation and microscopic examination.

CASE 2. (A269714.) A man, age 29, came to the Clinic May 1, 1919, with a swelling of the lower third of the left femur. Four months before he had received a severe injury in this area, and 6 weeks later the femur snapped as he stepped from a curbstone. The fracture was reduced and roentgenograms showed good position. Subsequently increased swelling and the roentgenographic findings led to further consultation and the diagnosis of sarcoma, which was verified by exploration. Microscopic examination revealed round-cell sarcoma. The patient refused amputation. Radium locally, roentgen-ray to the chest, and Coley's toxin were advised. The patient died 7 months from the date of his injury. The tumor had grown to an enormous size and had ulcerated.

The symptoms in the 109 cases varied with the duration and location of the tumor. The most constant symptom was mild, boring pain, especially with the central or myelogenous type of tumor. When the pain is severe it is usually the result of pressure on nerves and usually occurs in the periosteal or perforating central sarcoma. Fifty-five of our patients had dull pain, 12 had severe pain, 35 did not state the degree of pain, and 7 did not mention pain. Local swelling and varying degrees of tenderness may persist from the time of injury. The initial swelling may subside, followed in a few weeks or months by a slow or rapid growth. If the growth is in the region of a joint, a secondary

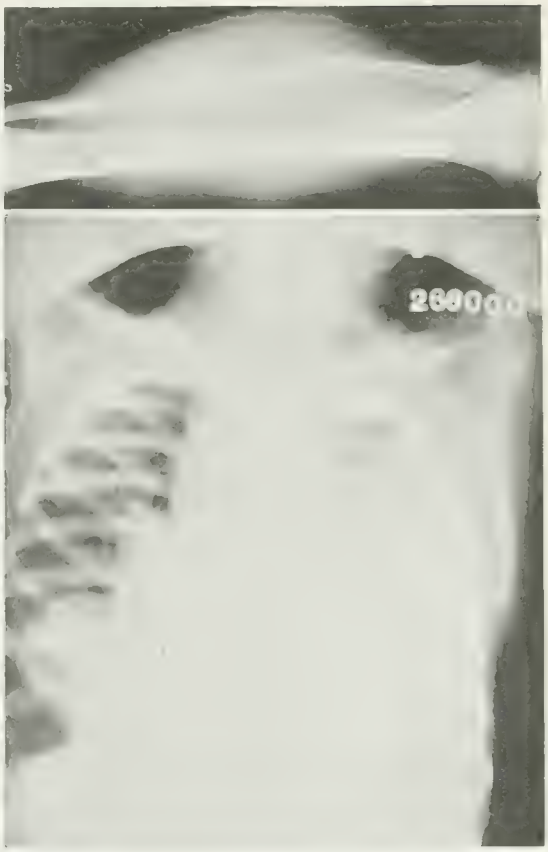


7	Round cell	2	1	Fibrosarcoma	8
	Chondrosarcoma	2	3	Round cell	
	Mixed cell	3	2	Osteosarcoma	
2	Mixed cell	1	2	Mixed cell	
	Round cell	1	1	Mixed cell	1
1	Chondrosarcoma	1	1	Chondrosarcoma	1
2	Mixed cell	1	1	Mixed cell	1
	Fibrosarcoma	1	1	Fibrosarcoma	
1	Chondrosarcoma	1	3	Mixed cell	6
			1	Round cell	
1	Chondrosarcoma	1	1	Osteosarcoma	
2	Round cell	1	1	Osteosarcoma	1
	Mixed cell	1			
19	Osteosarcoma	10	2	Fibrosarcoma	20
	Mixed cell	6	10	Mixed cell	
	Chondrosarcoma	2	4	Chondrosarcoma	
	Round cell	1	3	Osteosarcoma	
			1	Round cell	
9	Mixed cell	5	3	Chondrosarcoma	16
	Round cell	2	2	Fibrosarcoma	
	Chondrosarcoma	1	11	Mixed cell	
	Osteosarcoma	1			
4	Fibrosarcoma	1	3	Mixed cell	4
	Osteosarcoma	1	1	Chondrosarcoma	
	Round cell	1			
	Mixed cell	1	1	Mixed cell	1
1	Mixed cell	1			
1	Round cell	1			
50	Right side cases			Left side cases	50

Fig. 5. Type and distribution of sarcoma of the long bones.

Fig. 6. Mixed-cell sarcoma of the fibula.

synovitis may result and tuberculosis may be suspected erroneously. Early evidence of disturbed circulation, as shown by enlarged veins over the tumor, is often a symptom and should be regarded as important. Such tumors occur most often in the region of the knee joint, and it is important to note that pain, if severe, is not relieved by fixation. Joint motion is seldom impaired. Atrophy, therefore, does not occur early, and this fact, with the lack of relief by fixation, is an aid in the differentiation of tuberculosis. Further, patients continue to be up and around and are not disabled until either the tumor becomes large or pathological fracture has occurred. Not infrequently the patient walks into the physician's office with a tumor so large that pathological fracture is imminent. Local heat is often noticed around the tumor, and when complicated by a postoperative sinus, leucocytosis, and fever, it sometimes obscures the diagnosis. In 56 cases in



Figs. 7 and 8. Periosteal sarcoma of the fibula with metastasis to the lungs.

Fig. 9. Mixed-cell sarcoma of the tibia.

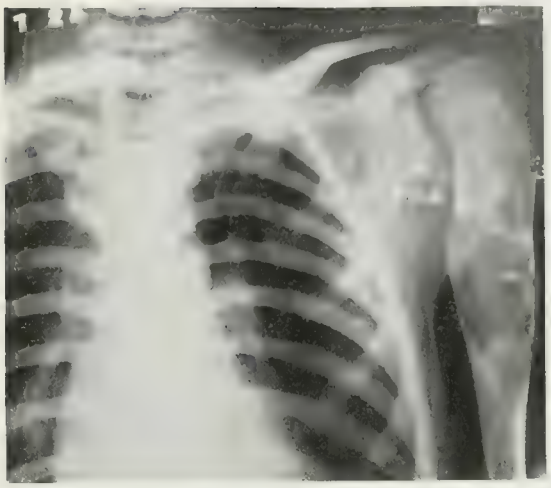


Fig. 10. Fibrocystic disease of the upper left humerus.

which there was a record of the blood examination, the average leucocyte count was 9,929; the highest count was 29,400.

Case 3. (A289738.) A girl, age 15, came for consultation September 17, 1919, stating that she had had influenza 9 months before, followed by fever and swelling in the upper left fibular area with slight pain, and loss of weight. She had been treated for several months by medication and external applications. Five months before a curettage had been done, and 3 months before a piece of bone had been removed. Examination revealed a sinus over a tumor, some local heat, hæmoglobin 55 per cent, and leucocytes 18,400. Roentgenograms showed destruction of the upper third of the right fibula. The tumor was explored and found to be mixed-cell sarcoma. Tourniquet was applied and amputation performed. The patient has remained well for 2 years (Fig. 6).

Loss of weight, pallor, and secondary anæmia occur early or late, depending on the degree of malignancy, the time of metastasis, and so forth. If the patient has a cough he should be carefully examined for evidence of pulmonary metastasis, which so often is a complication.

Case 4. (A266000.) A boy, age 6, was brought to the Clinic for examination March 21, 1919. He had had pain and swelling in the right leg for 14 months. Several exploratory operations had been performed. The child had a persistent cough which had followed an attack of influenza 4 weeks before. A large tumor was palpable in the calf of the right leg; the circumference of the leg was 12 inches, that of the left 7 inches. The superficial veins were prominent.

Fig. 11. Periosteal chondrosarcoma.

The temperature was 100°, the pulse 118. Primary periosteal sarcoma with metastasis to the lungs was diagnosed by the roentgenogram. The patient died within a few weeks (Figs. 7 and 8).

The tumors, arising as they do from bone or periosteum, are always fixed; they are usually firm, with a gradually sloping, elevating edge rather than with the overlapping edge of an exostosis. Occasionally, on pressure, crepitus may be elicited. The differential diagnosis of tuberculosis and sarcoma in a joint or close to a joint sometimes taxes the ability of the surgeon, and aspiration or exploration may be a necessary aid. While the symptoms of sarcoma are not characteristic, any tumor with persistent, dull, boring pain should make one suspect the condition, and if the growth is rapid and the superficial veins are dilated, malignancy should be suspected. Indeed, all growing tumors of the bone should be considered potentially malignant until they are proved benign.

The most characteristic symptom was localized pain. In some, firm pressure disclosed tenderness, and the consistency of the

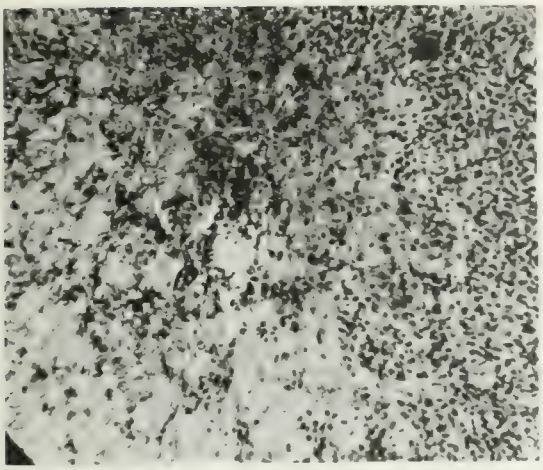


Fig. 12. Cellular area of a chondrosarcoma. X100.

tumors varied. Central lesions of the bone are not likely to be palpable until late, when the tumor passes through the bounds of the cortex and is easily outlined. Periosteal tumors usually grow more rapidly and invade the soft tissues, and thus are more easily recognized. The venous engorgement over the area of the tumor is a valuable clinical sign; it is not often noted with benign growths. Local heat is usual and in some instances marked, although rarely accompanied by redness or pain sufficient to simulate a low grade inflammatory process, unless infection is present.

A temperature of 101° is noted in some instances, usually in the late cases. Secondary anæmia and loss of weight occur rapidly in the most malignant types of the growth, the patient usually succumbing to pulmonary metastasis. Glands are not usually involved, but they should always be examined.

Case 5. (A365027.) A man, age 37, registered at the Clinic August 9, 1921, complaining of pain in the right knee, which he had wrenched in a jump from a wagon in 1903. There was no locking nor swelling. Two operations had been performed without appreciable results. In 1919, he had contracted influenza, and the knee had become very painful and swollen. He was unable to extend the leg. His knee had become progressively worse, and he had been obliged to use crutches. On examination, the patient was found to be in good general condition. The temperature, pulse, and blood pressure were normal. The enlarged right knee was markedly

Fig. 13. Osteosarcoma of the right femur.

tender and painful; it was held at fixation of 160 degrees. The urine contained an occasional pus cell. The hæmoglobin was 70 per cent and the leucocyte count 11,600. The Wassermann reaction on the blood was negative. Destructive arthritis of the right knee, with considerable synovial thickening, was shown in the roentgenogram. August 13, the right knee joint was opened and a sarcoma of the periosteum of the mixed-cell type was discovered. The tumor had originated on the posterior surface of the lower part of the femur and had pushed its way through to the anterior part of the joint. The thigh was amputated, and roentgen-ray, radium, and Coley's toxin were given. The patient returned in 2 months in excellent condition and is still under treatment.

When the patient was examined in the Clinic it was believed that his condition might be tuberculous, with secondary infection following influenza. He was warned, however, of the possibility of sarcoma, and his consent was obtained for an amputation

Fig. 14. Round-cell sarcoma of the right humerus.

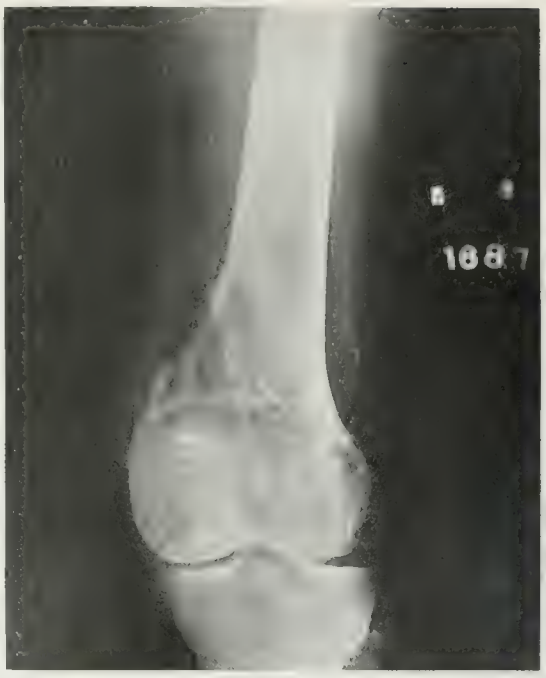


Fig. 15. Chondroma of the lower end of the femur.

if it should be necessary. The points of interest in the history of the case are that 18 years before the knee had been injured; it had been operated on elsewhere twice. During these years there was occasional stiffness and soreness in the knee. In 1919, following influenza, the knee became so swollen it could not be straightened. During the last 6 months the pain had been much more severe, and for the last 2 months the enlargement had been rapid. Whether the old inflammation had anything to do with the cause of the sarcoma is difficult to determine, but a few cases have been observed in the Clinic in which there was a long history of trouble of the knee joint and an apparently rapid development of sarcoma. So far as we could judge, the sarcoma in this case seemed to arise from the periosteum in the posterior part of the femur at just about the epiphyseal line. Primary sarcomata of the synovia are rare, and this case would have been regarded as a primary sarcoma of the synovia if the cross section of the specimen had not determined accurately its origin.

The roentgen ray obviously is very important in making a diagnosis and a prognosis of sarcoma of the long bones. It not only reveals the location, size, and to a certain degree the structure of the tumor, but, more important, the earliest signs of metastasis to the lungs.

Case 6. (A224326.) A man, age 23, came to the Clinic March 6, 1918, stating that he had been treated for lockjaw which had followed ulceration around a tooth 6 months before. About 1 month after this he noticed a swelling, without inflammation, in the left upper tibia. Local applications and chiropractic treatments had been given. He had had some pain and had been unable to walk. The tumor had continued to enlarge. The synovitis present had been interpreted as due to bone infection; there was no history of trauma. Roentgenograms taken at the Clinic revealed increased density in the upper third of the left tibia. Examination of the chest was negative. Syphilis was suspected, but Wassermann reactions were negative. The tumor was explored and a specimen excised. The pathologist did not find malignancy but suggested syphilis. Intensive treatment for syphilis was given for 3 weeks without benefit. One month after examination the leg was amputated, and a mixed-cell, periosteal sarcoma was found. Radium, roentgen-ray, and Coley's toxin were advised. The patient returned to the Clinic in 9 months, complaining of slight pain in the left hip. Metastasis to the lungs and left hip was seen in the roentgenograms. The patient's weight before amputation

Fig. 16. Hæmangioma of the right humerus.

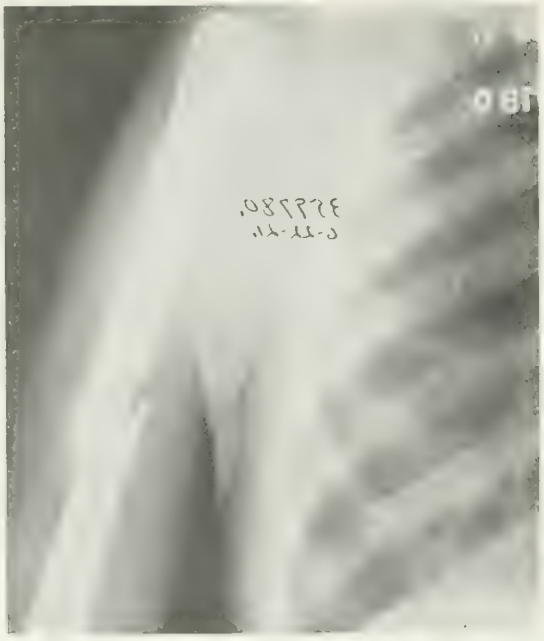


Fig. 17. Same case as in Figure 16, 21 days after excision and bone graft.

was 134 pounds; at the time of the last examination it was 135 pounds. He died within the next year (Fig. 9).

Case 7. (A239524.) A boy, age 12, came for examination July, 1918, with aching, pain, and swelling in the upper third of the left humerus. The arm had been severely injured 8 years before, possibly fractured. Two months before examination it had been traumatized. The arm was freely movable, and without pain or tenderness; a thickening of the upper third of the humerus was apparent. The parents and the child were greatly alarmed because cancer of the bone had been diagnosed and a Berger amputation of the shoulder advised. A diagnosis of fibrocystic disease was made in the Clinic from the clinical and roentgenographic evidence and a conservative operation advised. The thin shell of cortex was broken through and a specimen removed which verified the diagnosis; following this the wound was thoroughly curetted and closed without drainage. There was improvement in the bone as shown by the roentgenogram. The patient is alive and has good function more than 3 years after operation (Fig. 10).

Clinical signs of metastasis to the lungs appear long after the roentgenograms reveal the condition. The differentiation of periosteal or central (medullary) sarcomata may usually be made by the roentgenogram, although this differentiation is of doubtful value, malignancy and benignancy being the vital questions. Unfortunately, we are unable to detect metastasis until the tumors are large enough to be shown by the roentgenray (Figs. 11 and 12). Not infrequently operations are performed when metastasis has already taken place, thus giving the impression that the operation disseminates the tumor. Practically all patients ask, when exploration is advised: "But, doctor, will this spread the tumor?"

The two principal types of sarcoma of the bones are the periosteal and the central groups. The periosteal sarcoma is the most characteristic in appearance; fine lines of calcium salts in bone cast shadows of increased density which radiate outward in the manner of the sun rays, more definite at the base and fading away toward the surface. Absorption of cortical layers of bone may occur at the base of the tumor. The outlines of such tumors are usually lost in the periosteal structures so that the extent of the growth may not be judged accurately. At times this fan-like structure may be so faint as to be scarcely visible in the roentgenogram. Roentgenographic examination will not always determine the point of origin; late tumors often show cortical and medullary destruction equally, and the fine radiating

Fig.. 18 Chondrosarcoma of the left femur.

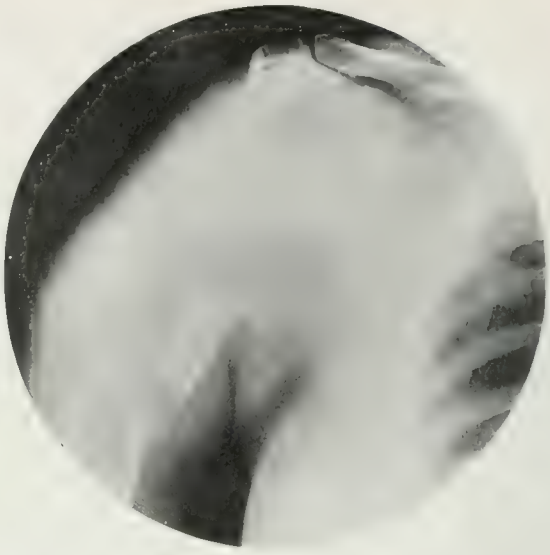


Fig. 19. Recurring chondrosarcoma. Patient living 5 years after amputation.

lines are absent; apparently growth is too rapid to permit the formation of bone, the tumor passing rapidly into the soft tissues before this occurs.

In some cases of large osteosarcoma a slight crepitus may be palpated and the roentgenogram reveals a fine line of bone at the margin (Fig. 13). The central type of tumors more often shows undifferentiated body structures which cast only slight shadows and an irregular, hazy border with a tendency to invade tissues in all directions, making it impossible at times to differentiate the growth roentgenographically from carcinoma (Fig. 14). Some osteosarcomata throw a more dense shadow, appearing either as a solid bony or heavily mottled mass with irregular definite outlines. While the roentgen-ray is invaluable in showing the location and extent of lesions, and may even suggest the type of the cell structure, too much reliance must not be placed on such interpretations, since extremities may thus be needlessly sacrificed.

Case 8 (A16792.) A woman, age 53, was examined August, 1916. She complained of nervous indigestion, insomnia, rheumatism, and lameness of the left knee. Lameness and stiffness had been present for 7 years, although there was no limitation of motion, no deformity, or tenderness. A diagnosis of sarcoma had been made elsewhere, and amputation of the hip had been advised. The urinalysis was negative; the hæmoglobin was 80 per cent; the leucocytes, 5,200. The tonsils were enlarged and contained septic material. Roentgenograms showed the presence of a tumor in the lower end of the left femur. Other roentgen-ray findings were negative. August 18, the tumor was explored and found to be a chondroma. Radium was used. April 5, 1917, the tumor was curetted and the cavity filled with fat from the abdominal wall. The patient has been walking now for 5 years. Thus far there is no clinical or roentgenographic evidence of recurrence (Fig. 15).

The roentgenographic appearance of metastasis to the lungs varies slightly; usually there are distinct circular areas of increased density, depending on the extent and number of growths.

TREATMENT

When a tumor of the bone is suspected of being malignant, roentgenograms of the chest are made routinely. The cough, with evidences of increased intrathoracic pressure, appear too late to be of diagnostic value. Metastasis to the glands or to other structures of the body should be ruled out if possible. The extent of local growth is then determined. After all possible means have been taken to rule out metastasis and syphilis,

TABLE V.—SARCOMA OF THE LONG BONES

Relation of type of cell found to duration of disease in total number of deaths—fifty-five cases

Type	Patients	Average duration of disease, months	Average length of life after operation, months	Average total duration of disease, months
Mixed-cell sarcoma	27	7.7	22.48	29.55
Round-cell sarcoma	9	10.8	8.6	19.5
Osteosarcoma	8	2.5	7.0	9.5
Chondrosarcoma	7	39.42	19.57	59.0
Fibrosarcoma	4	9.25	30.25	39.5

the type of treatment must be considered. The rapidity of growth and the duration of symptoms are important. The tumor should be explored before the limb is amputated. Many radical operations have been performed and limbs needlessly sacrificed because of failure to explore. With a tourniquet applied, exploration may be safely accomplished and the macroscopic and microscopic appearance noted.

Case 9. (A359780.) A man, age 58, came to the Clinic May 31, 1921, complaining of pain and swelling in the upper third of the right humerus of 6 months' duration. He remembered that 20 years before, a similar pain followed an injury and he was treated for neuritis. Just before the present attack he had twisted his shoulder. He came for consultation because sarcoma was suspected. Exploration was performed and the condition was diagnosed hæmangioma. The upper half of the humerus was excised and an homogenous bone graft implanted. The patient recovered satisfactorily, and returned to his work as a clerk (Figs. 16 and 17).

If metastasis is ruled out the treatment may be determined to a certain extent by the duration, site, and extent of the lesion. If the treatment is non-operative, Coley's toxin, radium, and roentgen-ray is administered. If it is surgical, the growth is destroyed locally by cautery, by excision, by excision and cautery, or by amputation, followed by non-operative measures. As I have stated, it is important to make a diagnosis early and remove the tumor, in the hope of preventing local recurrence and metastasis. Sixty-six of the 109 patients treated had amputations, 19 had excisions and cautery, and 24 had local operations of various types. Early in the period of the growths, local operation may appear satisfactory and patients may refuse amputation. Later the seriousness of the condition impresses them.

TABLE VI.—SARCOMA OF THE LONG BONES: ONE HUNDRED NINE PATIENTS OPERATED ON

One patient died in hospital (mortality—0.9 per cent) From September 1, 1907 to September 1, 1921

	Patients	Per cent
Living	48	44.11
Dead	53	48.1
Not heard from	7	6.4
Patients Living		
Lived 5 years or more	13	27.08
Lived 4 to 5 years	1	2.08
Lived 3 to 4 years	2	4.16
Lived 2 to 3 years	3	6.25
Lived 1 to 2 years	5	10.41
Lived less than 1 year	24	50.00
Patients dead		
Lived 5 years or more	4	7.54
Lived 3 to 4 years	2	3.77
Lived 2 to 3 years	6	11.32
Lived 1 to 2 years	9	16.98
Lived less than 1 year	31	58.49
Date of death not stated	1	1.88
All patients		
Lived 5 years or more	17	15.61
Lived 4 to 5 years	1	.91
Lived 3 to 4 years	6	5.5
Lived 2 to 3 years	9	8.25
Lived 1 to 2 years	17	15.59
Lived less than 1 year	49	44.95
Date of death not stated	2	1.83
Not traced	8	7.33

or the tumor may be large enough to be troublesome, and patients may wish to have the operation performed in spite of the hopeless prognosis. Amputation is preferred in such cases, since many patients may remain active in their environment until metastasis causes a rapid end, instead of being bedridden with a slowly destroying neoplasm (Figs. 18 and 19).

The average length of life in relation to the type of sarcoma is shown in Tables V. and VI.

Some surgeons recommend disarticulation of the limb close to the trunk, with removal of the origin of muscle whenever possible. However, the failure to prevent metastasis, and the increased mortality seem hardly to justify such procedure until further statistical evidence of cure has been produced. Local excision, followed by cautery and radium to prevent recurrence and roentgen-ray and Coley's toxin to prevent metastasis, may give good results in selected cases. In my experience, amputation and closure without drainage is the most certain means of disposing of the tumor. Local application of radium, roentgen-rays over the chest, and Coley's toxin are advised following operation. It is difficult to ascribe a definite value to any one therapeutic measure when several are being

used. I advise treatment by roentgen-ray following operation in order to obtain diffusion of the radiation as uniformly as possible in the chest and in areas of most probable metastasis, whether there is or is not evidence of metastasis, since this cannot be proved until it has resulted in a growth of sufficient size and density to cast a roentgenographic shadow. During or following radium and roentgen-ray treatment, Coley's serum is recommended.

SUMMARY

1. Thirty-five per cent of the patients were inoperable or refused operation. In many instances undoubtedly early diagnosis would have given the patients a chance for cure.

2. Thirty-two of the 35 patients who died had amputations. The average duration of the disease at the time of their examination was 7.34 months, and they lived an average of 14.5 months after operation. The average duration of life of the 32 patients was 21.9 months. One patient who had a fibrosarcoma was examined 9 months from the onset of the disease and lived 36 months after operation, a total of 45 months, the longest duration of life in those who have died following amputation.

3. The most malignant sarcomata in the series of 32 patients were the osteosarcomata. Eight of these patients, the average duration of whose symptoms was 2.5 months before examination, lived 7 months after operation, a total average of 9.5 months.

4. Ten patients have died who had had excision and cautery. The average duration of symptoms was 6.6 months, the average duration of life after operation, 28.2 months, and the average length of life from the time of the onset of symptoms, 34.8 months. One patient with osteosarcoma, who was examined 2 months after the onset of the disease, died 6 months after a local operation. Five patients treated by excision and cautery died of pulmonary metastasis.

5. Twenty-one (31.8 per cent) of the 66 patients in the series who had amputations are reported to have died of metastasis to the lungs. The average length of life of these patients was 21.9 months.

6. The value of microscopic proof of malignancy of tumors of the long bones is obvious, inasmuch as the fate of an extremity may depend on such proof. If any doubt exists with regard to the character of the tumor, section from various portions should be examined.

7. A diagnosis should be made only after thorough clinical, physical, and roentgenographic examinations have been made, and even then can not always be determined until an exploratory operation and microscopic examination rules out giant-cell tumor, chondroma, fibrocystic or cystic disease, syphilis, and osteomyelitis. The principal points to be decided before operating are malignancy, metastasis, and the extent of bone involved. With early diagnosis, with eradication of the tumor, with care to exclude patients with metastasis, and with the use of radium, roentgen-ray, and Coley's toxin, prolongation of life may be looked for following operation.

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SARCOMA OF THE LONG BONES[1]

By ASTLEY P. C. ASHHURST, M.D., F.A.C.S., Philadelphia

IT is narrated of Virchow, that he once said jocosely (if so august a mind can be said ever to have descended to jocoseness), that you could put a man to the torture and still he would not be able to tell you what a tumor was. Now it has been my fate to sit before you all this evening in torture, knowing full well that I was appointed to open this discussion on sarcoma, yet being perfectly well aware of my incompetence to discuss it in the presence of such recognized authorities as are with us tonight.

And yet I may say this: that surgeons know a great deal about tumors in general and about sarcomata in particular, in the same way that there existed about syphilis an immense fund of information derived from clinical observation and study, long before the cause of that disease was known. Note for instance the many advances in our knowledge about tumors since the days of Virchow: first perhaps, should be placed the doctrine of anaplasia, as deduced by Hansemann (1897); then there is the classification of tumor cells according to their derivation from the primary embryonal layers, as totipotential, pluripotential, and unipotential, for which, according to Adami, we are indebted to Barfurth; then we have the doctrine of the equivalence of the connective tissues, endothelium, lymphatic, mucous and fatty, cartilage, and bone-marrow (Malherbe, 1904), which really is not in opposition with the doctrine of the specificity of tumor cells as taught by that genius of French pathologists, Bard (1899).

These, you will say, are mere theories; and it is true enough that they are mere theories. But, after all, are theories of no use? What would thinkers have done through so many years without the theory of gravitation? And yet we are now informed that this theory is false. But everyone must recognize, in the science of medicine as in the more exact sciences, that it is imperative to have theories of some kind on which to hang our ideas, and by which to classify our thoughts. So it is for these purposes that I venture to think that the theories I have mentioned are still of use in surgery today.

It may be admitted that any cell in the body may give rise to a tumor. We know that some cells frequently give rise to tumors, as epithelial and connective-tissue cells; we know that others very rarely if ever take on a neoplastic character. But actually there is scarcely any cell in the body from which some student does not think he has observed a tumor developing. I am informed, for instance, that one recent investigator thinks he has discovered a tumor formed from erythrocytes, red blood cells. Though others may not agree with his conclusions they must admit that in theory the thing is possible.

Now we may with advantage go one step further in our theorizing, and admit that every cell which may produce a tumor may produce a tumor of embryonal, of intermediate, or of adult type. The tumors of adult type, which were called by Virchow, and lately by C. P. White, histiomata, are those which resemble (resemble, I say, but do not actually reproduce) the normal tissues; those in which no formed tissues develop are named cytomata, and in them the cells remain of embryonal type forever, and these tumors are malignant. But in accordance with the dictum *Natura non facit saltus*, there must also be recognized tumors which are neither histiomata nor yet cytomata, which are neither benign nor yet malignant, but intermediate in type. And these are the tumors which are the bane of the surgeon, for the pathologist merely replies, "I don't know," to all queries as to the prognosis as deduced from histological study. Thus it is easy to recognize the fibroma as a tumor of adult type derived from fibroblasts, and a spindle-cell sarcoma as a tumor in which the fibroblasts remain of embryonal type forever; but when some of the sections show fibrous tissue forming and others show cells of sarcomatous

[1] Presented before Clinical Congress of American College of Surgeons, Philadelphia, October 24–28, 1921.

nature, it is impossible to say that the tumor is either strictly benign or decidedly malignant.

In the realm of bone tumors particularly, are growths to be found about which no consensus of opinion exists among pathologists; and you have heard much tonight about the malignancy of true osteogenic sarcoma and the benignancy, relative or absolute, of the giant-cell sarcoma better called the myeloplaxoma of Eugène Nélaton (1860) or the myeloma of Malherbe (1904).

Now in regard to the term osteogenic sarcoma I desire to say this: osteogenic means bone forming; and if a sarcoma in bone forms bone, the more bone it forms the more benign must the tumor be, because according to the theory of anaplasia the fibroblastic cells are developing to their adult type, and are forming a tissue. Either, therefore, the theory of anaplasia is wrong, or the term osteogenic is poorly chosen to describe a very malignant form of tumor. The most malignant form of tumor in bone should be one in which the embryonal type of bone cell was best preserved. Such tumors have for generations been called round-cell sarcomata; though some modern pathologists exclude all "small round-cell sarcomata" as being really of lymphatic and not of osseous origin, and consider all "large round-cell sarcomata" really to be composed of fibroblastic cells very immature in type.

But it need not surprise us to learn that many a tumor might grow in bone and yet have no pathogenetic relation to the bone proper. For there are all the marrow cells in bone none of which has any necessary relation to osseous tissue, and yet these cells do, according to some authorities, act as the focus of tumor formation. In some of the lower forms of life, the marrow is not found within the bones (indeed these particular forms of life do not have any bones); but it is arranged as it were in glands which discharge their products into the blood stream, much as in the human body the secretions of the lymph glands are so discharged.

Now, it seems to me that the question of most interest to us tonight is whether any of the forms of sarcoma of bone, as we understand that term, are tumors which arise from marrow cells (and these after all are connective-tissue cells), or whether we must confine the term sarcoma to tumors which are developed from osteoblasts and the derivatives of these latter. Is there not something lucid and simple in the theory of Malherbe about these sarcomatous tumors? Namely, that since the original indifferent connective-tissue cells may, in the course of their development, form either bone or marrow, or for the matter of that cartilage, lymphatic, endothelial or fatty tissues, so the adult type of tumor may conform to the type of any of these tissues, according to the manner in which the cell develops. Thus he recognized the giant-cell sarcoma, which he named myeloma, as the adult (benign) tumor of bone marrow; the fibrosarcoma growing in bone marrow he recognized as the embryonal (malignant) tumor of bone marrow, and named it myelosarcoma. Certainly we occasionally see also tumors of intermediate type in bone marrow which are neither certainly benign nor absolutely malignant. And though the adult types of fibroma, lymphoma, and endothelioma are rare or unknown in bone, yet chondroma and osteoma (at least in the form of exostoses) are frequent; and we may with propriety name tumors of the intermediate type fibrosarcoma, chondrosarcoma, or osteosarcoma, implying that some at least of the tumor cells develop sufficiently to give a tissue characteristic to the growth; while the purely sarcomatous tumors we may perhaps still be allowed to name according to the predominant type of cell, round-cell sarcoma or spindle-cell sarcoma.

But these questions of pathogenesis must, for the present, be left unsettled, until continued pathological research sheds more light on the subject.

In regard to the question of conservative treatment of bone sarcoma, so ably advocated by tonight's speakers, I may be permitted to quote what I wrote nearly 10 years ago: "The usual advice is to do amputation as early as possible, the limb being removed at the nearest joint above the disease. But to one who considers the ultimate results, it is questionable whether anything is gained by

this but relief of pain. Internal metastases must often be present when the patient first comes to the surgeon, since they appear with such uniformity even after removal of the limb; and local recurrence is so apt to follow excisions or amputation in continuity, that there is no class of cases so disheartening." These statements apply to undoubted sarcomata of bone. But even in what appear to be highly malignant forms of growth, I now believe it proper to incise the tumor and secure some tissue for microscopical study: if the diagnosis of great malignancy is justified, the exploration will do no harm; if it proves wrong, a life as well as a limb may be saved by proper treatment.

For the benign myeloma, I am firmly convinced that amputation is rarely justifiable. Evacuation of the tumor and complete removal of its contents, with crushing in of its walls if the tumor is small, or transplantation of bone if the tumor is large or if a pathological fracture demands fixation, seems to me the method of choice. I am opposed to leaving to themselves, unexplored, what are thought to be benign tumors, because recovery will seldom take place without the aid of evacuation by the surgeon, and if the tumor is of the intermediate type, prompt operation may prevent it from becoming malignant; and many of these benign tumors, especially in adults, have an undoubted tendency to undergo malignant change.

In tumors of the intermediate type I believe that a conservative operation (evacuation) should be first adopted; local radical excision is indicated for recurrences, or even amputation in cases where truly radical excision would leave a useless limb or endanger the life of the patient.

I am sure it is proper to employ Coley's mixed toxins in all forms of bone sarcoma. His own results speak for themselves; and my own experience, though comparatively very limited, has taught me that their use may not only prevent but actually cure recurrences of tumors belonging to the intermediate type. As to radium, it appears to me that its true value has not yet been determined.

As regards the question of pathological fractures, I do not regard it as of great importance. I have seen pathological fracture in highly malignant sarcoma, and *as the first sign of desease* in osteomyelitis and in metastatic carcinoma, as well as in the benign bone cyst and in myeloma. It is a complication of the underlying disease, but does not alter the prognosis nor the indications for treatment.

There are so many questions still to be answered in connection with sarcoma of the long bones that it is well for us to be here gathered together in public to acknowledge our ignorance and to plan means of increasing our knowledge. For is not life short while the Art is long? Is not the occasion fleeting, experience fallacious, and judgment difficult?

THE REGISTRY OF CASES OF BONE SARCOMA

By E. A. CODMAN, M.D., F.A.C.S., Boston
Chairman of Committee on Registry of Cases of Bone Sarcoma for the American College of Surgeons

IN August 1920, the following letter was sent as a circular to every member of the American College of Surgeons:

Dear Doctor: Have you any living cases of bone sarcoma? I include in this question, recent cases which are now under treatment and also any cases which you may consider as having recovered.

I have a patient with a sarcoma of the ilium, who is having treatment with radium, and I am most anxious to get in touch with other surgeons who have similar cases, whether of the ilium or of other bones, or whether their treatment is by surgery, by Coley toxins, by radium, or by other agencies.

Dr. Bloodgood and Dr. Ewing are joining me in this investigation, and it is our intention to keep a file of all living cases in which the diagnosis is reasonably certain, and to send to each surgeon who contributes a case, a duplicate file of all the others. In this way each case will have the benefit of the experience of the rest. We feel that surgery has perhaps been a failure in such cases, and that today,

radium should be considered as offering more hope than surgery, at least in some cases where the position of the growth makes amputation too great a sacrifice.

Cases known to have died cannot be included in the investigation at present, but we should be glad to correspond with any surgeon who has (or is willing to do so) collected data about the past cases in his clinic or neighborhood, for it is important to confirm or disprove the conclusions from Bloodgood's series, i.e., that the periosteal infiltrating form has an almost universally bad prognosis, and the giant-cell medullary type an almost universally good one. We must also standardize the pathological nomenclature.

For the purpose of this investigation, cases which are diagnosed as sarcoma from the clinical data and the X-ray, without the removal of a pathological specimen, must be accepted, for, as in our case, it may seem best not to incise on account of the danger of provoking metastases. It may prove best to make this a rule, for apparently radium cures the benign forms and the limb is not needlessly sacrificed; and if the malignant forms, almost as a rule, recur rapidly in the lungs, whether amputation is done or not, it may be well to save the limb, if the growth can be held in check by radium.

We feel that these cases are too rare for each individual clinic to work alone, and that the plan outlined will bring before surgeons in general, in the most rapid possible manner, the facts as they develop.

If you can contribute one or more cases please send me a very brief description of each, and I will write you in greater detail about the plan above suggested. (Signed) E. A. Codman, M.D.

The ensuing correspondence developed the fact that many other surgeons were interested in the problem of bone sarcoma. One hundred and seventy-one wrote giving brief descriptions of cases which they believed to be bone sarcoma and three hundred and forty-five even took the pains to reply in a negative way, and expressed interest in the investigation.

A list of those who contributed cases was sent to each contributor, together with short abstracts of the cases reported. It was intended to keep up this plan and as each new case was reported, to send to the one who reported it, the list of all the others, in this way keeping all surgeons in charge of living sarcoma cases in touch with one another. Furthermore, our plan provided a mutual discussion of pathological material for Dr. Ewing and Dr. Bloodgood were willing to state their opinions on sections as a starting point for discussion. These opinions were of course tentative as the full data and complete examination of the cases could only be obtained by the individual surgical attendants of each case. However, with a brief history, X-rays and slides or tissue, a reasonable guess could be made as to diagnosis and prognosis. At any rate, the effort to diagnose and prognose on the data received has led to much interesting discussion in many laboratories and clinics. It has been made clear that the histological examination of tissue from bone tumors is subject to widely different interpretations. The terms used for the varieties of bone tumors are understood differently in different places, and even if there is a fair agreement among pathologists, there certainly is a very vague conception of the meaning of these terms in the minds of most surgeons.

Unfortunately, the particular patient in whom we were especially interested died on November 27, 1920. An autopsy showed that the bone tumor was a metastatic carcinoma, instead of a sarcoma. However, since the investigation had been started and a considerable amount of data collected it seemed a pity that other patients with sarcoma should not have the benefit of it. So it occurred to us to continue this clinical research as a permanent Registry of Bone Sarcomata. We had been gradually organizing such a registry (somewhat handicapped by expense), when some of those whom we had interested in it, suggested to the regents of the College that they should take the plan over as a part of the work of the College. This was done at the meeting in Philadelphia last October, so that the registry has now become a kind of committee responsible to the College and financed by it. It remains to be seen whether the members of the College will be interested enough in the plan to register the cases of bone sarcoma which occur in their practices. These cases are the units on which the registry must build in order to succeed.

Cases of bone sarcoma are a favorable class of cases to test the possibility of a national clinical research of this kind. They are so rare that it can never be a serious burden for any surgeon to report all those he may see.

These cases have a peculiar interest to most surgeons because they are usually conspicuous tumors, often of large size. Such a case in a hospital attracts everyone's attention and interest. Owing to the bad prognosis they are apt to go from hospital to hospital in search of optimism. Having seen a case, one usually remembers it, but seldom knows of its outcome. Thus each case is often seen by many doctors, none of whom knows the whole story. Even large hospitals have so few cases that their total number forms a small and unsatisfactory group for study.

Then too from the patient's point of view, a research of this kind is greatly needed. Owing to our ignorance of the various pathological entities sometimes called bone sarcoma and our ignorance of the results of different forms of treatment on the different varieties of lesions, no surgeon is today in a position to give very positive advice to these patients. Few individuals studying bone sarcoma have collected many cases to draw conclusions from, and each may be biased by his own predilection for some particular treatment. Certainly from the patient's point of view we cannot begin too soon to register each case. Each future patient with this condition must endure some experiment whether he wills it or not. Shall we not give them the benefit of each other's experience at least? How slowly and unscientifically this absolutely necessary series of experiments is being carried on at present! Limbs are being unnecessarily sacrificed, lives lost by procrastination, painful burns endured and distressing toxic phenomena borne with little effort being made to record and study the results. The public would be horrified if a laboratory was planning such an aimless and cruel series of experiments by hundreds of different experimenters who were not even intending to record their experiments so that their errors might not be repeated.

Under the existing conditions we cannot prevent this aimless experimentation which is bound to occur under our very eyes. Patients with bone sarcoma will be found occasionally in every part of the country. Inevitably the poorer ones will have to be treated by their local physicians or surgeons who will do the best they can under the existing circumstances. The ones who happen to have money will have to take their choice among experiments with radium, X-ray, Coley toxins, or radical and conservative surgery. Even the richest who may flit from expert to expert will have little advantage over the poorest who go from clinic to clinic or from "quack" to "quack." Every patient rich or poor is willy-nilly "experimental material." Shall we not at least make some record of this inevitable series of experiments, as our inexorable "civilization" marches onward?

It is far from the writers' mind to lose sight of the fact that the same argument applies to many other rare diseases. Life is too short and time too fleeting to permit us to record every instance of a rare disease, but we can as a profession concentrate on this one. The regents of the American College of Surgeons have adopted this registry and we may count on their wisdom not to overload us with too many others—particularly as in their own clinics they will each have to set an example!

THE PLAN OF WORK

It seems fair to ask every physician or surgeon who starts any form of treatment on a patient whom he *supposes* to have a bone sarcoma, to record the case with us as soon as he institutes treatment. He will, of course, have had X-rays taken. If he will forward us two good X-ray prints and a brief history, the case will be registered, whether an operation is planned or not. If an operation is done we want some tissue and will section it and send him a report of our diagnosis and prognosis. In return for this we trust he will keep us advised of the success or failure of whatever treatment he sees fit to give. We will gladly give such advice as we can if he desires it, but we recognize that the treatment of bone sarcoma is in such an unsatisfactory stage that no authoritative advice can be given. However, we can tell him what treatment similar cases are, at present, having and how it is succeeding.

This simple plan is the basis of the registry. The method of procedure is as follows: Correspondence, data and tissue should be sent to the registrar at 227 Beacon Street, Boston,

Massachusetts. Through the courtesy of the pathological department of the Harvard Medical School, the tissue will be sectioned and stained and an immediate report made, if requested. The history with the sections and X-ray prints will be forwarded in turn to Drs. Ewing and Bloodgood for their opinions on diagnosis and prognosis. The registrar on receiving these opinions will send copies to the doctor registering the case and answer any questions he may have about similar cases. At least once a year thereafter, the registrar will enquire as to the condition of the patient.

PUBLICATION

SURGERY, GYNECOLOGY AND OBSTETRICS will publish from time to time statements from the registry and devote a page of its issue each month to this purpose. The data collected will be at all times available to those who have registered cases, either for personal study or for use as material for scientific papers on this or kindred subjects. The Harvard Medical School has temporarily provided a room for the storage of specimens and other data.

FUTURE PLANS

Eventually the data and material collected by the registry will be placed in the new museum of the American College of Surgeons. Pending the completion of their building the collection may be sent temporarily to other institutions for the study of other pathologists. It will accumulate like a snow-ball, leaving education in its path. It is already of considerable educational value and if each surgeon of the country contributes his bit it will soon be worthy to place in the museum at Chicago, as a new kind of exhibit. It will be the first perpetually "up-to-date" museum collection, for it will always be dealing with "current" cases as well as recording past ones.

THE NOMENCLATURE OF BONE SARCOMA

Probably one of the reasons that what little knowledge in regard to bone sarcoma medical science at present possesses, is so poorly diffused among surgeons and pathologists, is the confusing nomenclature which has arisen. We do not use the same terms for the same clinical entities. It has been customary among pathologists to use descriptive terms to qualify the general term sarcoma. These terms are in the main "tissue" terms or "cell" terms. The "tissue" terms refer to the preponderance of elements of tissue seen either in the gross specimen or in the microscopic slide, e.g., fibro, osteo or osteoid, myxo. chondro, and their various combinations. They are used as we might use colors to describe spotted dogs. Black, tan, lemon, blue spots might be combined for instance as, black-lemon spotted dogs or lemon-blue spotted dogs. In the past an effort has been made, as it were, to predict the length of the life of the dog by the combination of his colored spots. It was attempted to attach a different prognosis to each combination as osteo-chondro, fibro-osteo, myxo-chondro, fibro-myxo-chondro, and so on to the mathematical possibilities of different combinations of five words. It is extraordinary to think that the students of the past should have attempted such distinctions when we realize that no pathologist or surgeon sees more than a few hundred cases in a lifetime and is ignorant of the outcome of the great majority of these.

However, the simile of spotted dogs is not quite true, for it does appear that the prognosis may vary to some extent according to the predominance of bone or cartilage, etc. Even the modern pathologist who uses these old terms intelligently in a purely descriptive way will admit that the more bone there is, the slower the tumor is probably growing. It takes time to form new bone; rapidly growing tissue is cellular. So that in fact, the modern pathologist, if he is going to use a qualifying term, needs one which will contrast each tissue with the proportion of atypical cellular tissue he finds with it. The old terms do not do this and they are well-nigh useless at present. They are used because of habit. We can continue to use them if we do not speak of them as clinical entities. It is useful at times to speak of dogs by the color of their spots, although, a lemon and white setter may be English or Llewellyn or "part hound."

Practically among those of us interested in this registry the term "osteogenic" is used for all the sarcomata for which the "tissue" combinations of names have been used in the past. As defined by Greenough, Simmons, and Harmer, an osteogenic sarcoma is one which is produced "by a tumor growth of the essential fibrous tissue made up of spindle cells, which is the accepted progenitor of the bone-forming tissues of the body. These cells are capable of differentiation into bone, osteoid tissue, cartilage, myxomatous tissue, and fibrous tissue, as well as into a more succulent and less differentiated mass of pleomorphic cells of irregular form and function and of high malignancy."

The word "osteogenic" must be distinguished from "osteogenetic" which is not synonymous. "Osteogenic" means derived from bone-forming tissue, while "osteogenetic" means a bone-producing tissue. An "osteogenic" tumor may produce a cellular tissue without bone, while a tumor not of bone origin, as for instance, myositis ossificans may produce bone. As a rule, however, osteogenic sarcoma will be osteogenetic at some point and evidence of bone production is generally to be found in these tumors. While almost always osteogenetic, they are as a rule also osteolytic. Their quality of osteolysis is almost as characteristic as osteogenesis. In some instances osteogenic sarcomata destroy bone with great rapidity. But we must remember that osteolysis is a normal attribute of the bone tissue. In normal bone repair both processes are at work.

Since "osteogenic sarcoma" means a real clinical entity to those of us interested in this study we shall continue to use it in our writings and reports, until a better term appears. This is the true bone sarcoma for which we shall issue serial certificates.

What has been said in regard to the "tissue" terms applies also to the "cell" terms. The time when small and large, round and spindle, polyhedral or mixed cell sarcomata meant anything has gone by. Even "giant cell" has ceased to convey a meaning, since the distinction between tumor giant cells and foreign body giant cells has been accepted. There was a time when a report from the pathologist of "giant-cell sarcoma" gave the surgeon the impression that death was advancing with giant strides. In spite of Bloodgood's repeated statements, even now this impression still prevails among those who only occasionally see bone-tumor cases. Practically, among those of us interested in this study, the term "benign giant-cell tumor" has come to describe a definite clinical entity. It is characterized as a rule by quantities of "foreign body" giant cells, scattered with remarkable uniformity through a spindle-cell stroma resembling granulation tissue. Histologically, it is indistinguishable from epulis. These tumors are benign, in that they do not metastasize. As our work progresses this clinical entity becomes more definite and we are more satisfied with the term. We avoid the use of the term giant-cell *sarcoma*. Giant cells of the true tumor type—formed by multiple mitoses—are found in greater or less degree in nearly all "osteogenic sarcomata." We think at present that they indicate rapidity of growth and that their presence in relative quantity may mean a poorer prognosis. This is one of the things on which the study may enlighten us.

As to the terms, small and large, spindle and round, we still use them as habits without great conviction of their worth. They certainly do not describe clinical entities. Those of us interested in this work do not say "round-cell sarcoma" to one another to describe any definite clinical entity, but occasionally to describe a certain section. A "round-cell sarcoma" would certainly not mean a true bone sarcoma (osteogenic) to any of us. It would suggest an angio-endothelioma or a myeloma, i.e., a tumor derived from the marrow cells or blood vessels in the marrow. It might be a metastatic tumor. A "round-cell sarcoma" is certainly not a clinical entity. The same may be said of "spindle-cell sarcoma." It describes no definable clinical entity. All osteogenic sarcomata contain spindle cells. So do benign giant-cell tumors and most other tumors of any kind. In fact these "cell" terms are even less useful than the "tissue" terms. They are confusing rather than helpful in classification as well as in diagnosis, progno-

sis, and treatment. The clinical surgeon will do well to abandon the idea that all these sarcoma terms are clinical entities with separate characteristics and prognosis. The pathologists may have understood these distinctions in the past, but our correspondence shows that many surgeons still use these terms as if speaking of entities.

Another set of confusing terms refers to the apparent central or periosteal origin of the tumor. These terms are of use, but do not signify clinical entities. They are chiefly applicable to description of roentgenograms or gross specimens. We say, for example, a central bone tumor, meaning that the X-ray or an operation demonstrates that the bulk of the tumor is in the center of the bone. In England and Canada and in our older literature, "medullary" means the same thing.

It happens that the majority of central or medullary growths are benign while the majority of periosteal growths are malignant, but this fact does not justify the common use of "periosteal sarcoma" as equivalent to saying that a tumor is malignant, nor can we speak of medullary sarcoma as being benign. It is a mere coincidence that the kinds of tumors which are usually central in the X-ray (e.g., giant-cell tumor, bone cyst, osteitis fibrosa, gumma, Brodie's abscess) are usually benign, while those that show periosteal bone production (i.e., osteogenic sarcoma) are usually malignant. If we bear in mind that osteogenic sarcomata are essentially tumors of the osteoblast, and that they may arise in the endosteum or periosteum or wherever there are osteoblasts, we shall not be confused. Central and periosteal sarcomata are instances of the same clinical entity—osteogenic sarcoma. Whether the accident, as to which portion of the bone the tumor arises in, will influence the prognosis remains to be seen. Bloodgood believes, on the ground of a few cases, that those of central origin have the better prognosis.

As a matter of fact as the cases come in to the Registry we have little difficulty in classifying them as belonging in one of four classes: malignant osteogenic sarcoma, benign giant-cell tumor, errors in diagnosis and the rare forms of primary bone tumors. Perhaps 50 per cent fall at once into the first two classifications without doubt on our part. Of the other 50 per cent, many are clearly inflammatory lesions, non-malignant growths of bone or cartilage, metastases and tumors of other tissues than bone. Only a very few are possibly the rarer forms of primary bone tumors such as myelomata and angio-endotheliomata. The diagnoses of pathologists who have seen these sections vary widely. As a clinical surgeon, I feel that such cases are not common enough and not understood enough to weigh in the question of deciding treatment. I must look to my colleagues in this matter to use the material collected by the registry to separate out from our unusual cases clinical entities which have a definite natural history and require definite treatment.

A BRIEF ANALYSIS OF OUR WORK UP TO JANUARY 1, 1922

In the original letter to the members of the American College of Surgeons, only records of *living* cases were asked for. From the point of view of the patient in whom we were then interested, whom we *supposed* had a sarcoma of the ilium, we should have been glad to know by what treatment any *living* cases had been cured. This same point of view applies to any individual case afflicted with bone sarcoma now or who may be at anytime in the future. As each individual must choose conservative or radical surgery, radium, X-ray, Coley toxins or some more experimental treatment it is important for those advising him to know of *all* successful cases following any of these methods of treatment. If the registry is kept up as planned, each future patient will have the benefit of these facts. He may take it for granted that all other past experiments have failed with the few exceptions reported in the literature and supported only by printed or pictorial evidence. At best the diagnosis of cases in the literature can only be supported by authoritative opinion and we know only too well how erroneous this may be. Our cases, however, will be supported by X-rays, tissue, and slides which can be restudied and compared as our knowledge advances. We must, therefore, not include cases diagnosed by even the

most eminent authorities unless slides or tissue have been preserved. Our own present opinions are merely our best guesses. We ask no one to agree with them. We ask anyone to place his diagnosis and prognosis beside ours, provided the slide or tissue is kept as a basis for some future student of the subject. We do not insist that a given case is not a sarcoma because we think it is not. *Any pathologist may register a case which in his opinion is a bone sarcoma, whether we agree with him or not, provided he files the evidence on which he bases his diagnosis.* However, we shall not register any case on the "say-so" of even the most eminent pathologist unless accompanied by tissue or slide.

In the case of patients for whom a non-operative treatment is chosen we must perforce be content without tissue. However, we must insist on good X-rays in these cases. If, for instance, a considerable series of cases treated by radium without incision accumulates, the X-ray prints will be almost as valuable evidence as actual tissue. In fact, the X-ray is in many cases quite positive evidence and it would not take a very large number of cases clinically cured and supported by only X-ray evidence for diagnosis, to convince any fair minded person of the value of any method. The same may be said of the Coley toxin method, or of future untried methods. *But if operation is done sooner or later we insist on tissue.*

CASES REPORTED AND REGISTERED

Total cases about which we have had correspondence	454
Cases excluded for lack of X-rays, slides, or tissue or obviously incorrect diagnoses	317
Cases which we have little doubt are instances of osteogenic sarcoma	41
Cases of giant-cell tumor	43
Cases still undetermined or other tumors	53
Cases of osteogenic sarcoma living over 5 years	4

It will no doubt be a surprise to many who read this paper to find how few cases we have been able to collect in the year and a half since this work started. *We know of only four cases of true bone (osteogenic) sarcoma which are alive in this country today, who were treated over 5 years ago.* These were all treated by amputation alone. [1]No other proved cases are known to be alive who have recovered under any other form of treatment. These four cases are those of Bloodgood and Follis, Hubbard, Wells and Rixford. There are a few others under dispute, but we are not quite satisfied with the evidence. Even in these four cases the X-rays have not been preserved.

When one considers that we have corresponded concerning 454 cases, which were reported to us as "supposed-to-be-bone sarcomata," it seems surprising that they have boiled down to so few. There are many reasons for this fact.

In the first place most of our correspondents have not preserved slides or tissue of their cases, and we cannot recognize the report of the most eminent pathologist as evidence. It is clear that many hospitals do not preserve tissue or slides of their cases for more than a few years. The same is even more true of X-ray plates. If this registry had no other excuse for being than as a depository for specimens and X-rays, it would perform a very useful function.

We hope from now on that we may be able to keep duplicate sections and roentgenograms of every case. In another 5 years we shall have evidence on which to compute the actual percentage of cures. At present, we only know that the ratio is four to a very large number. This leaves everyone in doubt as to what a patient's chances are of recovery if amputation is done. It may be one in one hundred or one in one thousand. Considering that we know that many amputations have been done for benign conditions and that thus far we have met with no instance of the metastasis of a giant-cell tumor, the alternative of whether to amputate or not rests on what the chances are if we do amputate. This we at present do not know. It is certainly a very small chance.

Another great reason why we have not been successful in finding more living cases is because hospitals, as a rule, have no follow-up systems. What knowledge we have comes from private cases in which the surgeon has taken an interest in the individual patient. Doubtless there are a few living cases from every large hospital clinic if effort were made

[1]Murphy X-ray treatment in case of Hubbard.

to find them, but many of the busiest surgeons in this country write that they know of no living cases. In Boston, I feel quite sure that there is only one 5-year cure which can be substantiated, and Bloodgood, whose experience is great, can prove but one in his community. Ewing, with all his experience in New York, cannot produce evidence of a single 5-year cure which is not open to question.

It may be that our criteria are rather difficult to obtain, but the answer to this is that there are many living cases now registered which we all agree are osteogenic, but which are less than 2 years since operation. Death usually occurs from lung metastasis before the end of the third year. We expect these patients to die—in fact, a number have already died within the year and a half of the study.

Another reason for our discarding many cases is that on examination we find them really instances of other bone tumors, such as, metastases from cancer, thyroid adenoma and hypernephroma, inflammatory conditions, syphilis, myositis ossificans, osteitis fibrosa, etc. Greenough, Simmons, and Harmer in their review of the bone sarcoma cases for a 10-year period from two up-to-date clinics, the Massachusetts General and the Huntington Hospital, found 148 listed as bone sarcoma, but on restudy could find only 66 which might be considered true primary malignant bone tumors, including giant-cell tumors provisionally. They state:

"Perhaps the most surprising fact of the whole study is that out of 148 cases sent in as possible bone sarcoma only 66 could be considered in fact to be cases of malignant new-growth of bony origin; the remaining 82 cases proving on more detailed study to be metastatic tumors of bone (29 cases), sarcoma primary in the soft parts (28 cases), inflammatory conditions (11 cases), or tumors of a non-sarcomatous type (14 cases)."

It is not surprising, therefore, that the percentage of errors in isolated clinics is even greater. In fact, as in the case of the patient for whom this study was originated, a supposed-to-be-bone sarcoma is usually not a sarcoma at all.

OUR CALL FOR HELP

No matter how improvement in our knowledge about bone sarcoma is to come, it must be founded on the facts about the cases. This committee will be fully occupied in studying the data it receives. If it does its duty in receiving and arranging and studying the data, it should be able to rely on the members of the College to collect and send in the data. Few surgeons see so many of these cases that it will be a very serious burden for them to send us histories, X-ray prints and tissue or sections.

Isolated surgeons not connected with important teaching clinics have stood by us thus far better than the men connected with large institutions in the bigger centres. One reason for this is that in large hospitals the saying, "What is everybody's business is nobody's business," holds true. We hope that each such hospital will have the *esprit de corps* to help our registry along. An individual may be appointed to register all bone tumor cases or each individual may register his own "supposed-to-be" sarcomata. We want to make it a general custom for every surgeon to send us tissue from his cases *at once* just as he sends it to his own laboratory. And if the surgeon fails we want the pathologist to do it. If he will share what tissue he gets with us he is welcome to any information we can give him about other cases.

DATA FOR REGISTRATION OF A CASE OF BONE SARCOMA

Name and Address—
of doctor registering case
of patient
of friend, with permanent address, who would be likely to answer follow-up letters
of family physician
of surgeon operating
of roentgenologist
of pathologist
of hospital. Record reference or hospital number

Dictate history so as to cover following headings, and typewrite four copies on standard typing paper.

Clinical note. Date it was made. Age at this time. Race. Sex. Bone involved—part of bone. Date of trauma, if any, character of trauma—date and duration of pain, swelling, tumor, fracture, loss of function.

Any other important clinical data.

Examination. Date and by whom. Notes on local disease, especially as to swelling, tenderness, loss of function, involvement of joint. Presence or absence of bone shell. Pulsation. Size and extent of swelling.

Brief note on general examination. Especially blood, Wassermann. Urine, Bence-Jones bodies. Physical examination of chest. Date and diagnosis of first X-ray. From X-ray whether considered central or periosteal. If there are no X-rays or prints to be sent, give as complete a description of the X-rays as possible. Note as to whether X-rays of other bones and chest were made, and results.

Treatment. Date or dates of treatments. Operation—exploratory incision. Piece taken for diagnosis. Curetting. Partial excision. Complete excision, extent. Bone transplantation, from where. Amputation, exact position. Coley serum. X-ray. Radium. Any other treatment.

Gross pathology. Description at operation or of specimen.

Microscopic. Description and diagnosis.

Condition at date of last examination or report. Date of this.

Have sections been preserved by you? Sent to registry with this? To be returned or preserved?

Have X-rays been preserved by you? Sent to registry with this? To be returned or preserved?

Has gross material been preserved by you? Sent to registry with this? To be returned or preserved?

Make four typewritten copies, keep one and mail three to Dr. E. A. Codman, 227 Beacon Street, Boston, Mass.

HOW TO REGISTER A CASE OF BONE SARCOMA

Cases eligible for registration: Any case which has been diagnosed as sarcoma of bone with sufficient certainty to justify the beginning of any kind of treatment on that basis. The investigation is not confined to the long bones, but includes instances of sarcoma arising in any bone whether primary or secondary. For the present, we include cases of giant-cell tumor (except epulis of gum), although probably not sarcomata at all.

We do not wish to wait for certainty in diagnosis, but if an exploratory incision is to be made, we would like a good-sized piece of tissue removed. It is felt that there may be some cases in which, for good reasons, exploratory incision is inadvisable, and the clinical and X-ray diagnoses are satisfactory enough to justify the institution of treatment. We desire to follow such cases as well as microscopically proved ones. It is enough that the case is "a believed-to-be-sarcoma," and is being treated in good faith.

In fact, we welcome every case of bone tumor for a preliminary study. Certificates with serial numbers will be issued by the registry in each case in which we feel satisfied of the diagnosis of sarcoma.

The history of a case for registration may be made out in two ways: Either take the record and dictate the history according to the scheme which is on the preceding page; or give the entire history to a stenographer and have it copied, just as it appears in your records.

Four typewritten copies will be of the greatest convenience, the physician registering the case retaining one for future reference, on which he can place the registry series number when he receives the final report. The three copies go to Dr. Codman, one to be retained by him, two to be sent to the pathologists with the sections.

A most important thing to know, which usually does not appear on the history, is whether gross material, sections, or X-ray plates have been preserved. In future cases, send us a good-sized piece of the tissue in 10 per cent formalin, so that it may be kept for study in later years. Be sure to send X-ray prints and to see that the original plates are permanently preserved, or sent to us to preserve.

In cases where the patient is of sufficient intelligence, it should be explained that the information given about his case is similar to what you will have access to about all other cases of the same disease in others; that his disease is a rare one; that the details about his case will help other sufferers as well as himself; that he will have the benefit of expert pathological opinion and, in fact, a national consultation for his own benefit and that of future patients with this lesion. Impress on him the importance of keeping the registry informed, if he should become dissatisfied with your treatment, and go to some other doctor or clinic. He or his friends should understand the experimental nature of any treatment, and the importance of recording the failure or success of what you or any one else does for him.

THE CLINICAL SIGNIFICANCE OF ABDOMINAL PAIN IN CHILDREN[1]

By JOSEPH BRENNEMAN, M.D., Chicago

AT THE very beginning I hasten to disclaim the temerity of attempting to discuss with any assumption of authority or of completeness this vast and notoriously uncertain subject. I make bold to believe, however, that the general practitioner and the pediatrist have a broader outlook over the significance of abdominal pain in children than has the surgeon to whom has been assigned by common consent, and wisely, but perhaps not always wholly so, a superior diagnostic ability in the abdominal conditions even of children. The reason for this view is clear enough. It is the "surgical belly" that comes to the surgeon for differentiation, or perhaps even more often, for corroboration. There is a "medical belly" also, if I may use a short, ugly, contrasting phrase, that is a hundredfold more frequent than the former. In both, pain is an equally cardinal symptom. In the borderline cases, and beyond, we anxiously demand the surgeon, in the others we would often rather not see him. The task that I would set myself, then, is to present briefly as I see it, the pediatric attitude and viewpoint in the presence of a child with an abdominal pain. This will naturally include a consideration of a sort of proportional incidence of the different types of pain and of the conditions that produce them at various ages.

To one unaccustomed to children as a routine, and especially to babies, the inability of the child to tell about his symptoms might seem a serious obstacle to accurate diagnosis. This view the pediatrist will sharply deny. In fact he is often thankful that his little patient communicates only true facts, in his own little way, and his inability to talk too much is sometimes, indeed, gratifying. In general, too, it must be remembered that tenderness, which is easily estimated if one has the proper pediatric tact and patience, is usually of greater value than unelicited pain. The cry, the posture, the wince, the squirm, the expression of the face, in the baby are as significant and often far truer than any spoken word in the adult. It is also true that the pathology that underlies the abdominal pain in infants and even in older children is less multiform and its manifestations in general more characteristic than in the adult, and that the causes of "catastrophic" abdominal pains are much fewer in the young child than in the adult and are generally more easily recognizable. Nevertheless the clinical significance and the importance of abdominal pain in children are complex and uncertain enough "to crave wary walking in diagnosis," as Hutchison has well put it.

Approaching the subject then from the pediatric viewpoint one can say:

1. That there are certain abdominal pains that are common enough in adults that are rare, or practically unknown, in infancy and even early childhood. These need only to be mentioned in this connection. Such pains are those of chronic gastritis; of ulcer and carcinoma of the stomach; of biliary colic; of gastric crises in tabes dorsalis. Renal colic is certainly rare. I have never encountered it to my knowledge. The same is true of movable kidney, and of the pains of perforated gastric and duodenal and typhoid ulcer and of acute pancreatitis. Salpingitis, in spite of the apparent frequency of gonococcus vaginitis in infancy and early childhood, ranks as a curiosity that few of us ever expect to see. Appendicitis is apparently a great rarity in the first and even the second year.

2. That there are some forms of abdominal pain that have the same significance and the same characteristics at all ages, or at least in older children and in adults. These need not concern us.

3. That there are other pains that occur wholly or predominatingly in infancy or in early childhood. Of those thus occurring in infancy, nearly all are caused by the obstruction of a hollow peristaltic viscus. Three

[1]Read before the Chicago Medical Society. March 2, 1021

stand out conspicuously: colic, and the pains of indigestion; those due to intestinal obstruction, acute ileocolic intussusception greatly predominating; and the paroxysmal pain of pyloric stenosis. Great distention and pain from an overtight anal sphincter is rarer than any of these but no less real. In older children green apple, or corn, or grape, "colic" is much more frequent than in the adult. Other forms of abdominal pain that occur relatively frequently in the child are those that accompany throat infections and pneumonia. Less frequent but no less peculiar to childhood are the referred pains from tuberculous spondylitis, from acute hip disease and from pericarditis; the pain of acute non-appendiceal peritonitis; the multiform pains of tuberculous peritonitis; the abdominal pain that accompanies rheumatism and Henoch's purpura; the sharp paroxysmal pain that goes with a distended bladder with no causal pathology; and lastly the pains due to acutely inflamed mesenteric and retroperitoneal glands and to sarcoma of the kidney or other abdominal organ. Of worms I can only say that, in my experience, if a worm has ever caused an abdominal pain I have not been aware of it, though pain from that source cannot be denied.

4. That there are still other pains that manifest themselves rather differently in the child at various ages and also as compared with the adult, or perhaps rather that offer greater difficulties in diagnosis. Here only appendicitis will be considered.

Our present concern is chiefly with the last two classes and some of these may well be taken up in such detail as their importance or their frequency warrant.

Colic easily heads the list as the most frequent and the most distressing and yet one of the most easily recognizable of the abdominal pains of infancy. Its peculiar age incidence that has led to the not inappropriate lay term "3 months' colic" and that places it in a time when other severe pains are most infrequent; its characteristic paroxysmal manifestations; its striking daily periodicity with sudden onset at about the same hour; its varying, agonizing course, and equally sudden departure; its amelioration rather than aggravation when pressure is applied; its complete relief often when flatus is expelled freely as with an enema; its freedom from fever, leave no doubt as to the diagnosis. Real major "colic" is always intestinal in origin. A purely gastric form of colic, the colloquial "up" variety, in contrast to the "down" variety just considered, is even more frequent than the latter but always less distressing. It occurs immediately after or even during nursing in both breast- and bottle-fed babies, often with each feeding, and is due to an overdistention of the stomach from both food and gas or air. Every mother recognizes it and knows how to relieve it.

Babies with indigestion, especially if chronic, cry a great deal from abdominal distress. This is usually quite constant, is not as severe as that of colic, and is nearly always accompanied by evidences of dyspepsia, such as diarrhœa, that point to the real cause of the pain. Some babies, however, cry a great deal from causes associated with nutrition and digestion without showing other tangible evidence of such disturbance, but they rarely give any serious concern from a diagnostic standpoint. In all of these conditions the babies pass gas and fæces and so give one no worry about intestinal obstruction.

Pyloric stenosis is rarely accompanied by severe pain. Many of these babies, however, cry a great deal, and twist and squirm from discomfort and that coincidental with the recurrent advent of visible peristaltic waves. Later in the course there is often apparently little or no sensory response at all in the presence of marked hyperperistalsis. One who is at all familiar with the symptomatology of pyloric stenosis and has the condition in mind can, however, hardly be led astray by these pains that are a part of it.

Intestinal obstruction is peculiarly, though by no means invariably, a disease of infancy and furnishes the high peak of dramatic interest. By far the most frequent cause is intussusception of the ileum and cæcum into the colon. It seems rare in earliest infancy, the youngest I have seen was in the third month. I cannot recall having seen it in any child beyond the second year, except in a boy of 7 or 8 years who at two different

times had an invagination of the small bowel alone.

Contrary, I believe, to the usual impression gained from textbooks, the degree of pain in intussusception is a very variable quantity. It cannot be emphasized too strongly that severe paroxysmal pain, at the time the child comes under observation, should never be considered a desideratum to a diagnosis, or to a suspicion of a diagnosis of intussusception. The severe pain and shock so commonly pictured as occurring at the beginning are often quite absent, possibly due to a long mesentery. While rather severe intermittent pain probably occurs at some time in nearly every intussusception it has been my experience that in the majority of cases at the time I have seen them pain has not been a distressing symptom. Often there is only a slight squirming, or wincing, or change of position, at fairly regular intervals. Shock, too, is often more absent than present. In so many of these cases in older infants there is on the contrary a peculiar psyche that I think is of diagnostic value. The child lies abnormally quiet, has a serious, intent look, not of pain, but of preoccupation, and is not normally interested in its environment. In others there is a definitely toxic look that is accompanied by some rise in temperature that is almost the rule in intussusception. Tympany is usually quite absent.

All of this leads very easily to a diagnosis of enteritis, or ileocolitis, especially if there are a number of stools containing blood. The dysentery stool, however, contains fæces with blood and mucus quite separate from the rest; the stool of intussusception after the first movement or two contains blood and mucus intimately intermixed without fæces. Of great diagnostic value is the escape of a small amount of turbid, reddish, grayish, thin, jelly-like substance after the retreating finger following a rectal examination. Only once have I failed to see this symptom.

The absence of severe pain and of tympany should never lead one to omit a careful search for the characteristic sausage-shaped tumor, which is *the* cardinal symptom. Only once have I been unable to find it, and in that case it nearly escaped the surgeon at the operation because of its peculiar location low down in the pelvis. In the great majority of cases the tumor is easily found, early in the transverse colon, later in the descending colon, or still later in the rectum. I have only once found it in the ascending colon. An anæsthetic is rarely necessary, but may be helpful.

A peculiar pain that I have never seen in any other intussusception occurred in a chronic, or possibly recurrent, intussusception that lasted over a period of 10 days in an infant of 8 months. Fæces and gas were passed daily without blood. There was no other symptom of note except that with nearly every attempt to nurse, the child would strain and bear down as if straining at stool. After a time the pains would cease but the child finally refused the bottle from fear of the pain. There was a little tenderness and a suspicion of a mass at the hepatic flexure. About the tenth day a sausage-shaped tumor was evident in the middle of transverse colon. This was easily unfolded at operation with uneventful recovery, and with no apparent explanation for long duration.

Intestinal obstruction due to volvulus, or to a band, either congenital or the result of previous inflammation, acute or tuberculous, is a much rarer condition in infancy. I have seen but one volvulus and that in a newborn infant. The intestines were twisted *en masse* about the mesentery as a pedicle. The symptoms were not unlike those of pyloric stenosis except more severe, and the gastric waves pointed toward and below the umbilicus. In two cases of obstruction due to Meckel's diverticulum, the pain and symptoms were much like those of intussusception except that there was no definite tumor and no blood in the stools. The tenderness was a little above and outside of McBurney's point.

Another type of intestinal obstruction that leads to great abdominal distention and pain I have seen twice in young infants with a pathologically tight anal sphincter. In one such case seen with Dr. Gerald Krost the abdomen gave one the impression of a "surgical" or at least pathological belly. The other was in an infant of 2 weeks that had severe paroxysmal abdominal pains during which the

colon would rise up clearly visible and palpable, extending as a straight tense tube an inch in diameter from the left groin to the region of the gall bladder. The rare passage of gas was attended by a loud report; and the introduction of a catheter caused a sound of escaping air and a flattening of the abdomen quite like that of a large puncture in a tire. The little finger could not be inserted into the rectum at the first visit. Gradually one larger finger after another and finally the thumb were inserted over succeeding days with prompt and complete cure, the mother assuring its permanency by occasional repetition of the treatment. I am inclined to think that minor grades of this condition are more frequent than is generally thought.

Of the abdominal pains that occur most characteristically in older children as compared with infants on the one hand and adults on the other, three stand out most conspicuously: the type best represented by the term "green apple" colic, or stomach ache; the referred pain of pneumonia; and lastly, of far greater frequency, the abdominal pains that go with throat infections.

The first of these usually gives but little trouble in diagnosis. Following the ingestion of certain foods, commonly in large quantities, notably unripe apples or bananas, grapes, corn, cucumbers, peanuts, etc., severe colicky pains, referred at least at first to the stomach, occur with great severity often accompanied by vomiting and sometimes later by diarrhœa with occasionally a convulsion. The knowledge of a causative factor, often revealed in the vomitus, the location of the pain in the stomach, the absence of tenderness, indeed the relief from pressure, should easily differentiate this from the "catastrophic" abdominal conditions. In a generation in which a knowledge of dietetics, true or otherwise, has trickled down through all the social strata, "green apple colic" has become a rarity except in the rural districts in late August and early September.

That pneumonia is a frequent cause of abdominal pain in children is a matter of common knowledge. So well known is this to the surgeon that he hesitates, sometimes too long, to operate on an appendix in a child unless the symptoms are unmistakable or a right-sided pneumonia can be excluded. It is also well known that pneumonia often gives no definite physical signs for several days. The general picture, the nature of the respiration, the high temperature and leucocyte count usually make the differential diagnosis possible to one who is familiar with pneumonia in all its stages. If doubt remains the matter can usually be settled readily by an X-ray picture of the chest which will reveal a consolidated area before it is apparent to any other examination. I recently saw with Dr. Pelton, Jr., of Elgin, a child of 22 months, in profound shock with a generally distended and tender abdomen, with rapid grunting respirations, the whole thing coming on suddenly after a week's illness of some kind. It was quite impossible for several of us, including the surgeon, to decide to our own satisfaction whether we had to deal with a peritonitis due to a general infection or a ruptured appendix on the one hand, or a pneumonia that was not yet evident to clinical examination. In suspected right-sided lower lobe pneumonias differentiation between low consolidation and liver dullness is not always easy, especially in the presence of a distended abdomen. Only after a frankly negative X-ray picture was pneumonia excluded, and the child operated upon. A ruptured appendix with extensive peritonitis was found, the appendix was removed, and the child recovered. While pneumonia of the right lower lobe with a diaphragmatic pleurisy involving the lower intercostal nerves can usually only be mistaken for appendicitis, the involvement of either side or of the pericardium can lead to trouble by simulating a peritonitis or other abdominal trouble.

While acute abdominal pain can occur with a pericarditis, probably because of involvement of the diaphragmatic pericardium, it is relatively rarer than that of pneumonia. I recall one such case, however, in which an abdominal operation was done for appendicitis with negative findings. Two days later there was heard, for the first time, a pericardial rub.

It is to the third type of abdominal pain that I would like especially to direct attention, that which so often accompanies throat

infections. By throat infections I mean that whole series of upper respiratory tract infections that shade indistinguishably from the ordinary local cold up to a generalized septicæmia. Sporadically we have these cases with us always. Several times each year they reach epidemic peaks that in the number of cases involved dwarf to insignificance those of all other contagious diseases put together. In general they form nearly 50 per cent of a practicing pediatrician's work, at times more nearly 100 per cent. In both the sporadic and epidemic cases abdominal pain is so frequent a symptom that its presence attracts one's attention first of all to the throat. In certain epidemics it is the most prominent symptom in a considerable percentage of the cases. It is probably the most frequent single abdominal pain encountered in childhood beyond the period of infancy. For some reason this pain has apparently not crept into our textbooks and is not mentioned in a number of extensive recent papers on abdominal pain in children. In spite of this omission it is a very definite entity and often gives us much worry.[1]

This pain is commonly paroxysmal, or intermittent, sometimes very mild, again so severe as to cause crying with each recurrence. When asked where the pain is located the hand is quite regularly placed over the umbilicus. If asked to point with one finger, the umbilicus is again indicated. At times the pain is more diffuse, sometimes referred to one side or the other. When it occurs on the right side and below the level of the umbilicus the abdominal spectre begins to stalk. Fortunately pain is quite regularly greater than tenderness, rather the reverse of what obtains in appendicitis, and the tenderness is rarely as pronounced as in the latter. Unfortunately tenderness and involuntary rigidity do not seem as reliable a guide in appendicitis of children as in that of adults.

The presence of an upper respiratory tract infection in a child presenting these symptoms in the lower right abdominal quadrant must be carefully weighed, but it must not lead to the exclusion of sound surgical judgment. In one such infection with a red throat and very little pain and tenderness in the region of the appendix, operation was deferred rather by the surgeon than by the rest of us. After several days the abdominal symptoms were clearer and a gangrenous appendix was removed. It is my impression that appendicitis may form a true complication of such a grip-like infection.

It would not be difficult to cite several cases of this kind in which the abdomen was explored to no effect, or an innocent appendix removed. The first case of this sort, seen with Dr. Rittenhouse and Dr. Kanavel some 10 or 12 years ago, made a deep impression on me. A child of three years with a moderate temperature had a throat infection with bronchitis and a double otitis media. The abdomen was greatly distended, very painful and tender, with no apparent localization. Extensive consultation led to a postponement of operation. The condition became worse in the succeeding days as the abdomen more and more dominated the picture. Pressure from the parents finally tilted the scales in favor of an exploratory laparotomy. Nothing was found except a few hæmorrhagic spots in the intestinal walls and an extensive inflammatory enlargement of the mesenteric and retroperitoneal glands. The child gradually recovered in spite of the operation.

The cause of this pain is not clear. It is quite surely not due to indigestion, nor is it a referred pain from the lungs, or the mediastinum, or from a complicating acute vertebral arthritis, for evidence of trouble in these regions is wanting. To assume that it is a Head zone merely begs the question. I am inclined to think that it is not always due to the same cause. In those cases in which it is an early transient symptom, it rather seems like a colicky or gas pain. In little children who hardly distinguish between pain and nausea, which is so commonly present, early nausea may be a factor. In those cases in which it is not an initial symptom, in which it is more persistent and steady and in which there is some little tenderness, I am inclined to think the pain is due to inflamed mesenteric and retroperitoneal glands. There is a good deal of evidence that such inflammation is rela-

[1] Brenneman, Joseph. The abdominal pain of throat infections. Am J. Dis. Child., 1921, xxii, 403–9.

tively frequent in such cases, evidence obtained both from exploratory laparotomies and from the postmortem table, and occasionally from the palpation of masses through the abdominal wall. The route of infection could be either systemic or locally from the intestine due to the action of the specific organisms from the throat that are constantly swallowed. In some of these epidemics enteritis is a prominent symptom. Possibly in those other cases, localized inflammations without diarrhœa may occur as the causative factor. Perhaps the term intestinal grippe is, after all, not a bad one in these cases if properly used.

This pain usually does not outlast the other evidences of infection. In some cases I have seen it last for weeks and in a few apparently off and on for months. A variable degree of glandular inflammation might account for these differences in duration. In these prolonged cases we probably overlap a peculiar chronic recurrent pain of unknown etiology in older children, always located at the umbilicus, to which Moro gave the name of "umbilical colic." Chronic appendicitis here comes into consideration. It is apparently, however, most rare in children.

When these infections become systemic, peritonitis may form a terminal complication, especially in infants. Peritonitis from some such cause is certainly, in my experience, far more frequent in very young children than that following appendicitis, or than appendicitis itself. The nature and cause of the abdominal pain and tenderness in these cases is not long in doubt as the complete picture of a general peritonitis unfolds itself rapidly. While peritonitis is here probably usually a part of a generalized bacteræmia, as is, for example, an encephalitis, I am inclined to believe that it is occasionally due to the rupture of such an acute gland as I have described in connection with throat infections. I can never forget a child of 8 months that seemed to belong in this category. An initial mild sore throat and an even milder otitis media of one side was followed by a febrile course of 6 weeks' duration, the temperature reaching 105° and 106° nearly every day. There were no other symptoms and no demonstrable pathology to any of us who carefully followed the case. One lateral sinus was finally explored with negative results. Under the anæsthetic I was able to feel a smooth, roundish, oval mass the shape and size of a large pecan, perfectly discrete and movable, situated a little lower than McBurney's point. About 48 hours later the attention was suddenly focussed on the abdomen which had apparently been wholly negative except for this mass. A rapidly developing peritonitis beginning apparently in the lower right quadrant led to an early operation in that region. There was a large amount of free pus, and conditions were such that the surgeon did not consider it wise to remove the appendix, or even examine it. I do not believe that the appendix could have reached such a size without giving definite evidence of pain and tenderness in that region and I have always felt that the cause of the peritonitis was a ruptured gland. Unfortunately there was no autopsy.

Tuberculous peritonitis is another cause of a variable amount of abdominal pain depending upon the stage of development, and probably occurring much more freely in older children than in adults. There may be very slight pain early, though often considerable discomfort; later there is the pain of distention in the more serous type, and of obstruction in the more plastic type, and still later there may be the pain of obstruction due to old adhesions. The insidious onset; the low temperature; the presence of characteristic, indefinite, doughy masses or of fluid; the positive von Pirquet test and sometimes other evidence of tuberculosis leave little doubt as to the clinical significance of the pain, at least in the older child. In the very young infant tuberculous peritonitis is extremely rare, and this fact adds to the difficulty in making a diagnosis at this age. Age should not weigh too heavily in the balance, however. I saw one case of several months' standing in an infant that died at 4½ months of a generalized tuberculous peritonitis with extensive adhesions and a large amount of fluid that contained great numbers of tubercle bacilli. Obstructive symptoms with severe colicky pains and great distention were the prominent clinical features.

A type of abdominal pain occasionally found in children that can easily lead to a mistake in diagnosis is the referred pain of a tuberculous spondylitis due to pressure on the posterior nerve roots and carried along the lower intercostal nerves to the abdominal walls. This may occur early in the disease but *not earlier* than recognizable spinal rigidity and tenderness. This fact, together with the superficial location of the pain, rarely leave any doubt as to its source. A similar pain due to an acute condition such as has been reported recently I have never recognized in a child. I am sure that it is not the cause of the abdominal pain that accompanies throat infections as seen in children.

Another pain that I imagine occurs only in children and not infrequently is that from an overdistended bladder with no demonstrable pathology. I have seen a child of about 4 years of age scream with paroxysmal abdominal pain that had been present for some hours with a bladder distended to the umbilicus. With proper encouragement he emptied the bladder apparently completely and was immediately as happy as one might imagine he would be. There was no further trouble. It must be remembered that often one finds the bladder very much distended with apparently very little discomfort both in infants and older children. The typical, smooth, pear-shaped tumor is always easy to find, and, if we have this condition in mind, this form of abdominal pain, or its absence, rarely leads to diagnostic difficulties. Catheterization can always be resorted to, but I have never seen it necessary.

A painful, distended bladder is also occasionally found in younger circumcised boys having an ulcerated *meatus urinarius* due to the "ammoniacal diaper."[1] Painful urination is here the evident cause.

A final word as to appendicitis in children. Pain is here always a symptom and probably always the first, though it is often very slight. It apparently shifts from the umbilicus to the location of the appendix, just as in the adult. In infancy it is hard to diagnose for obvious reasons, but is fortunately very rare, so far as I know. I have personally seen to my knowledge only one case under 3 years of age, and this came in a child of 22 months with what seemed a well-developed, general peritonitis without localization. Much younger cases have been reported in considerable numbers. In older children appendicitis seems to differ relatively little from that of adults, except that the pain and tenderness seem less decisive and the temperature less high. The diagnosis, or rather the exclusion of appendicitis, is relatively more difficult in young children than in older children and adults, partly because the symptoms seem less prominent, but much more so because of the far greater incidence of pains in the lower right quadrant and other vague abdominal pains due to other causes already mentioned. The pediatrist and the general practitioner are called upon not so much and certainly not so often to demonstrate the presence of an appendicitis, as to exclude it by finding some other cause for the pain and it often keeps us anxious, for a mistake with resulting delay might be fatal.

The following recent case epitomizes the difficulties and uncertainties that sometimes confront us. A child of 5 with no tonsils has a throat infection with slight bronchitis. The case drags on for a week with almost no remaining temperature. Suddenly at 6 p.m. the temperature shoots up to 104°, there is a chill, the respirations become rapid, short and grunting, there is an anxious, drawn expression about the face, the abdomen is painfully distended and tender, especially on the whole right side. The belly certainly gives the impression of being pathological, possibly surgical. Examination of the lungs, however, seems to reveal dullness in the lower right lobe higher than normal liver dullness and the presence of fine inspiratory râles that are found nowhere else. The impression is changed. Pneumonia is suspected and so reported to the family. The morning's report is anxiously awaited. The temperature has dropped steadily during the night and is practically normal and remains so. When seen at 8:30 a.m., 14 hours after the onset, the patient is sitting up in bed laughing and playing with his toys, and continues as well as before the flurry. What was it?

[1] Brenneman, Joseph. The ulcerated meatus in the circumcised child. Am. J. Dis. Child., 1921, xxi, 38–47.

THE GROSS PATHOLOGY OF BRACHIAL PLEXUS INJURIES

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THE numerous unsatisfactory results obtained from the treatment of brachial plexus paralysis stimulated me to carry out an experimental study of the gross pathology of the various types of brachial plexus injuries, by attempting to produce on cadavers 2 or 3 hours after death an injury equivalent to that received in life.

In reviewing the literature two distinct views are maintained with regard to the etiology of brachial plexus paralysis; first, that the injury is primarily of the brachial plexus, and second that it is primarily of the shoulder joint and the brachial paralysis a subsequent result. Duchenne, in 1872, first called attention to birth palsies. He described paralysis of the newborn with an involvement of the fifth and sixth cervical roots. Erb, in 1874, described paralysis of the brachial plexus, traumatic in origin, which he stated was identical with the Duchenne obstetric birth palsy, a lesion of the fifth and sixth cervical roots. These lesions have been found to coincide with lesions found by Taylor and Casamajor and Thomas, except that the paralysis at first was complete and the arm hung as a flaccid extremity; this gradually improved and left an involvement of the fifth and sixth cervical roots. Taylor and Thomas are the two principal exponents of these views, and numerous articles and cases have been presented by both.

Taylor and Casamajor, in 1913, reported six cases of "traumatic Erbs' paralysis," in which the paralysis was due to a separation of the upper roots. It was their belief that the roots were lacerated in order from the fifth cervical downward, the cervical fascia being the first structure to tear, next the nerve sheaths, the nerve itself, and finally the blood vessels, producing hæmatomata, which were followed by inflammatory reaction and scar tissue. Five patients were operated upon with not highly gratifying results. Aside from the removal of the scar tissue, end-to-end anastomosis and nerve bridging were advised; the two latter procedures have not been very satisfactory in the repair of peripheral nerves. In 1913, Taylor reported a series of cases and stated that it is difficult to operate on intraspinal injuries and injuries of the roots close to the intervertebral canal, and that little benefit can be expected. The subluxation that occurs is, in his opinion, the result of an infantile condition of the clavicle, scapula, and humerus, with a marked subsequent traumatic neuritis. Massage and passive motion aggravate the condition and even though surgery does not offer a great deal it is the best means of relief. In 1920, Taylor stated that patients with obstetrical birth palsy seldom recover completely, as is maintained by the pediatrician and the neurologist, and while surgical treatment brings about some improvement, too much should not be expected of it. Spontaneous recovery should be looked for during the first 3 months only. Taylor reports having operated on 70 patients with only three deaths, and of having seen in consultation 130 additional patients not operated on. Only 10 of these patients were under 2 months of age.

In October, 1910, Thomas presented a paper on the laceration of the axillary portion of the capsule of the shoulder joint as a factor in the etiology of traumatic combined paralysis of the upper extremity. He stated that birth palsy is due to the influence of scar tissue following effusion of blood and synovial fluid from a lacerated capsule of the shoulder joint with subluxation. This article was supplemented, in 1916, by one in which he stated that the general surgeon usually ascribes the lesion to an injury of the brachial plexus, and ignores the ankylosis and pain at the shoulder; he referred to Duchenne's article in which four cases were reported of posterior subluxation of the shoulder and of internal rotation with paralysis. Thomas further states that Duchenne, in 1872, in his third edition, reported four other subluxations, but Thomas believes that still other

Fig. 1. An elongated laceration of the brachial cords and peripheral nerves produced by a downward outward pull on the brachial plexus.

subluxations were overlooked. He states that when a palsy is due to an injury in the region of the shoulder and is associated with ankylosis of a shoulder joint, it disappears with the restoration of the normal motion to the shoulder joint, that the injury to the plexus must be due to injury of the joint, that perfect recovery will take place by the aid of exercise, provided there is no displacement. In most chronic cases posterior subluxation with an internal rotation is found, and he suggests a reduction of the shoulder joint, if possible, by manipulation, otherwise by operative procedure with abduction of the arm. In 1917, Thomas again emphasized that brachial paralysis in most cases is secondary to joint injury and that it disappears with a complete recovery of the joint injury. Nerve lesions with stiff and painful joints recover without surgery and the repair of flail joints and the reduction of dislocations place the lesion in this former group in which recovery takes place. In 1920, Thomas reported 18 cases of injury to the shoulder in 12 of which operation was performed. In 9 the paralysis disappeared, in 2 it is disappearing; 1 of the patients died. Besides these 18 cases he has seen 44 birth palsies, which he had reported, in 1914, as pseudo-birth palsies. He continues to adhere to his original contention that "on the normal side the upper end of the humerus projects a variable distance in front of the anterior edge of the acromion. On the side of subluxation it can not be felt from in front and by careful palpation with the finger the anterior edge of the acromion can be located a considerable distance below its normal level. On the normal side there is a hollow under the posterior border of the acromion; on the affected side, a prominence."

In 1908, Schultz reported 54 uncomplicated cases of shoulder dislocation. Paralysis developed in varying degrees in 75 per cent of his patients. There were no brachial nerve complications at the time of the injury; the lesions developed subsequently, which is contrary to the manifestations in cases of classical obstetrical birth palsies or brachial plexus injuries in which the paralysis is frequently complete for several weeks and then improves and is limited to certain roots.

Fieux, in 1897, found experimentally that he was able to tear the brachial roots by forcible separation of the head and shoulder in the cadaver.

Delbet and Cauchoix, in 1910, collected 35 cases of brachial plexus injury from necropsy findings and surgical reports, and in none of these was a distinct rupture found; in every instance, however, there were extravasations of blood and inflammatory and cicatricial tissue. Taylor reported twenty dissections on ten infant cadavers, 3 to 10 days after birth, and found that tension was the only factor in the production of the lesion. Thomas applied forceps to the cadavers of six babies and was unable to rupture the brachial plexus by traction.

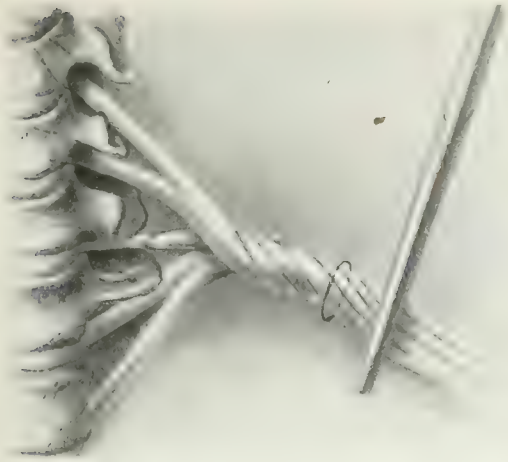

Fig. 2. Laceration of the seventh cervical nerve root with partial laceration of the fascia and fasciculi of the eighth cervical and first thoracic nerve roots produced by forward torsion with traction on the brachial plexus.

Fig. 3. Laceration of the first thoracic nerve root with partial avulsion of the ganglion and partial laceratoni of the eighth cervical and seventh cervical nerve roots with partial avulsion of the ganglion of each produced by backward torsion with traction.

A review of the literature shows that injuries in obstetrical birth palsies involve the fifth and sixth roots more frequently than the others, that the injuries are very slight in some cases and that rarely, if ever, a complete laceration of the root occurs. Examination of the plexus shortly after birth discloses very little, but if the paralysis is permitted to continue for several months a mass of scar tissue close to the roots probably with involvement of the roots is found. The presence of scar tissue so remote from the shoulder and axilla leads one to believe that the scar tissue is a result of injury to the cervical fascia, epineurium, perineurium, and the rupture of blood vessels and fasciculi. While subluxations occur, particularly in breech presentations, and in cases in which extreme abduction of the arm is necessary, many dislocations in chronic birth palsy no doubt are the subsequent result of the infantile development of the shoulder joint.

A study of 101 cases of brachial plexus injuries observed at the Mayo Clinic, 45 of which were birth palsies and 56 brachial plexus injuries due to direct blows on the plexus over the shoulder, associated in some instances with fractures and dislocations, falls, severe torsion, and gun shot and stab wounds with varying degrees of paralysis, leads me to believe that the treatment of brachial plexus injuries depends on the cause and the degree of the injury, and that no one method, medical, neurological, or orthopedic, should be used as a panacea for all brachial plexus injuries.

EXPERIMENTAL STUDY

Since my material was insufficient for a study of obstetrical birth palsy immediately following the injury and the death of the patient, an attempt was made to reproduce experimentally five groups of injuries of the plexus due to trauma of the neck and shoulder.

I first attempted to produce the injuries on the fresh cadaver by applying traction and torsion on the arm and shoulder in various directions, without exposing the brachial plexus, and by applying approximately 150 pounds pull. Dissections of the brachial plexus and shoulder were then made, but grossly no pathological condition was found. After the brachial plexus had been dissected free, exposing the fifth, sixth, seventh, and eighth cervical and the first thoracic roots, the upper middle and lower trunks, and the outer, inner, and posterior cords, the same pull was applied again, demonstrating which portions of the plexus were under the greatest strain. It was observed that if the pull was

Fig. 4. Laceration of the first thoracic nerve root with partial avulsion of the ganglion and partial lacerations of the eighth cervical, seventh cervical, and sixth cervical nerve roots with complete avulsion of the ganglion of the eighth cervical and seventh cervical, and partial avulsion of the ganglion of the sixth cervical nerve roots produced by exaggerated backward torsion and traction.

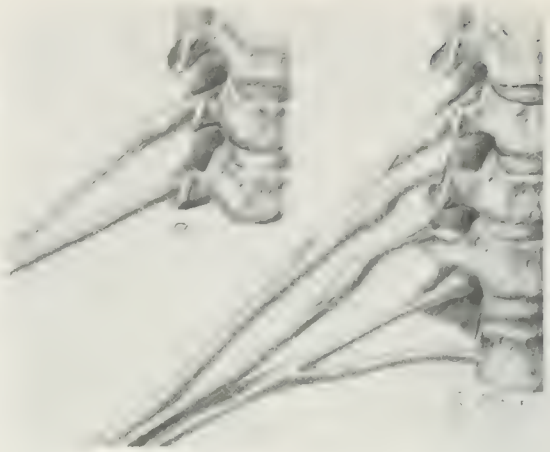

Fig. 5. *a*. Laceration of the fifth cervical nerve root and partial avulsion of the ganglion and tension on the sixth cervical nerve root produced by forcible downward traction of the shoulder with counter traction of the head. *b*. With increase in tension the result is complete laceration of the fifth cervical nerve root with partial avulsion of the ganglion, and partial laceration of the sixth, seventh, and eighth cervical nerve roots, with complete avulsion of the ganglia of the sixth and seventh cervical nerve roots and partial avulsion of the ganglion of the eighth cervical nerve root.

made gradually the tissues composing the nerve root, trunk, and cord would withstand greater force than if the pull was made with a jerk, giving proof that the fascial attachments connected with the nerve sheaths aid in the protection of the nerve roots and trunk, and that the torsion pull and upward traction place a great strain on the muscles and ligaments at the shoulder so that it is readily understandable why injuries severe enough to injure the brachial plexus would also produce dislocations and fractures near the shoulder. Injuries produced by the downward pull with a forcible separation of the head and neck and by the oblique outward downward pull resulted in very little injury to the shoulder. As the experiments were repeated from time to time it became evident that practically the same types of injuries took place in precisely the same manner so far as avulsions and lacerations were concerned.

Group 1. The experimental injuries of Group 1 represent an accidental injury in which the pull is downward and outward, as when the hand is caught and a sudden attempt is made to release it by jerking away. The tension was equally distributed over the nerve roots, trunks, and cord; the first structure to break was the fascial sheath, the second, the blood vessels about the cord distal to the nerve trunk. After stretching and lacerating the nerve sheaths a narrowing of the brachial cords was noted; as further tension was applied more laceration in the epineurium was produced with breaking of the fasciculi, until finally there was a complete, elongated laceration distal to the nerve trunk in the three cords. This particular type of injury was significant inasmuch as it spread over a distance of from 8 to 10 centimeters, that is, the fasciculi broke at various levels under different degrees of tension and when the laceration was complete a group of attenuated fibers was present. It also illustrated that when the pull was equally distributed over all of the nerve roots, trunks, and cords, the gross injury was not near the intervertebral canal but distal to the brachial cords, thus making the surgical repair very difficult since resection of approximately 8 to 10 centimeters would be necessary before all of the fibers could be found in cross sections. In addition there was marked injury to the fasciculi throughout their entire course above

and below the site of the complete laceration. After the injury had been produced, the bodies of the fourth, fifth, sixth, and seventh cervical and first and second thoracic vertebræ were removed, and the cervical cord with the roots and ganglia were lifted out so that a more extensive study could be made. The findings already obtained were corroborated (Fig. 1).

Group 2. The experimental injuries of Group 2 represent an injury produced by forward torsion with traction, as in belt injuries, in which the hand or arm is caught and rotated forward. Tension was first applied over the cervical fascia around the cervical roots, particularly to the seventh cervical root; the latter was the first to give way, next the epineurium, and last the fasciculi with complete division distal to the spinal ganglion but proximal to the nerve trunk. As the tension was increased, the first thoracic and eighth cervical roots showed evidence of involvement, followed by the sixth and then the fifth cervical roots. This is of significance on account of the particular involvement of the seventh cervical root, and is probably accounted for by the fact that the seventh cervical root is the shortest of all of the roots making up the cervical trunks of the brachial plexus. Non-avulsion of the ganglion with laceration of the root outside the intervertebral canal is probably accounted for by the fact that even though the tension is greatest on the seventh cervical root, it is also distributed over the eighth cervical root and the first thoracic root. In jerk injuries in which all the tension was practically on one root, avulsion of the ganglion and spinal root usually took place; the fascia over the ganglion of the seventh, eighth, and first thoracic roots was frequently lacerated, which resulted in an inflammatory reaction and scarring, and accounts for the severe pain experienced in brachial plexus injuries (Fig. 2).

Group 3. The experimental injuries of Group 3 represent injuries similar to those produced by forward torsion with traction in which the hand or arm is rotated backward. The first effect of the injury was on the first thoracic root; the fascia and epineurium

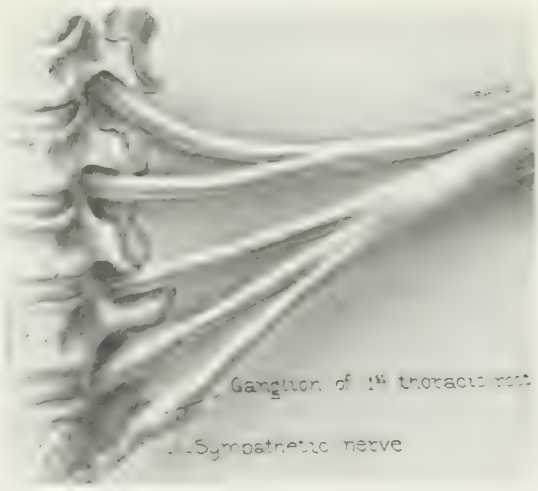

Fig. 6. Partial laceration of the first thoracic, eighth cervical, and seventh cervical nerve roots with complete avulsion of the ganglia of the first thoracic nerve root and the eighth cervical nerve root and partial laceration of the sympathetic connection with the first thoracic ganglion produced by forcible upward and backward traction.

became lacerated; this was followed by complete laceration of the roots between the ganglion and the lower brachial trunk, laceration of the fascia around the ganglion with partial avulsion of the ganglion, considerable tension on the fascia around the root of the eighth cervical nerve, and slight tension on the fascia around the root of the seventh cervical nerve. Increased rotation and traction resulted in avulsion of the ganglion and spinal roots of the eighth and seventh cervical nerve roots and partial avulsion of the sixth cervical ganglion. These results again emphasize that the injury is not abrupt and confined to one place, but that tension applied to a particular root may produce not only laceration of the nerve roots, but also partial or complete avulsion of the ganglion and spinal root. In some instances the spinal roots break between the ganglion and the spinal cord; in other instances they pull out of the spinal cord, thus illustrating how difficult and unsatisfactory operations are in this type of injury, which may be just distal to the ganglion or in it, or between the ganglion and the cords, or perhaps in the cord itself. Horner's syndrome is frequently produced by this group of injuries (Figs. 3 and 4).

Group 4. The experimental injuries of Group 4 represent injuries produced by forcible downward traction of the shoulder with counter traction on the head and neck such as is caused by blows, by falling objects, or by a person being thrown from vehicles and striking on the tip of the shoulder and side of the head. Falling objects striking midway between the shoulder and the head may produce injuries of the fifth, sixth, and seventh cervical roots of the plexus. These injuries simulate to a great extent those of the external popliteal nerve as it passes over the fibula or those of the ulnar nerve at the elbow. While the continuity of the nerve may be left undisturbed, the injury may be severe enough to destroy the blood vessels and axons, causing inflammatory reaction and considerable scar tissue. In the experiments the forcible downward pull usually resulted in laceration of the cervical fascia, epineurium, and blood supply before there was much apparent injury to the fasciculi. As the tension was increased, however, complete laceration of the fifth cervical root took place between the ganglion, and the nerve trunks, in addition to partial avulsion of the ganglion and spinal roots. A further increase in tension brought about injury to the sixth cervical root, to the seventh cervical root, as well as moderate injury to the eighth cervical and first thoracic roots, and resulted in avulsion of the ganglion, laceration of the spinal roots of the sixth and seventh cervical roots, and injury to the fascia of the eighth cervical roots. This injury illustrates the result of tension applied principally to the various roots in order from above downward; it is the most common of the Erb-Duchenne paralysis, usually spoken of as obstetrical birth palsy. The degree of tension determines the extent of injury (Fig. 5).

Group 5. The experimental injuries of Group 5 represent injuries produced by forcible upward and backward traction when the body falls downward and the arm and shoulder are suddenly jerked upward in an attempt to break the fall. The results are a tear of the fascia at the ganglion of the first thoracic root in the intervertebral foramen, avulsion of the ganglion and the spinal roots of the first thoracic and eighth cervical roots, laceration of the sheaths in the seventh cervical roots distal to the ganglion, moderate laceration of the sixth and fifth cervical roots, and partial laceration of the communicating sympathetic branches which are attached to the spinal ganglion of the first thoracic. This injury is also productive of Horner's syndrome, and is further confirmatory of the facts that involvement of the first thoracic root results in the production of this syndrome and that when injuries are confined chiefly to one root they result in laceration of the sheaths at the nerve root and ganglion with partial or complete avulsion of the ganglion.

Gunshot and stab wounds of the brachial plexus are very similar to those of the peripheral nerves except perhaps that the extravasation of blood and the formation of scar tissue may result in the involvement of nerves other than those directly injured. The treatment followed in cases of peripheral nerve injury is indicated (Fig. 6).

SUMMARY

1. Injuries of the brachial plexus, except those described under Group 1, are situated in the vicinity of the intervertebral canal proximal to the brachial trunk.

2. The injuries may be slight, lacerating only the fascia around the cervical roots, or they may be severe and result in laceration of the cervical roots between the cervical ganglion and the cervical trunk, with or without avulsions of the ganglion.

3. Inasmuch as injuries of the brachial plexus are produced in the root or the ganglion, they seem primarily to be lesions of the nerve rather than secondary to lesions of the shoulder joint.

4. Patients with milder injuries may be expected partially or completely to recover without surgical treatment, but those with more severe injuries rarely recover, even with surgical treatment.

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SURGICAL ANATOMY OF THE TRIGEMINAL NERVE[1]

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THE surgery of the trigeminal nerve, with particular reference to the treatment of trigeminal neuralgia, has been discussed more or less extensively since 1886. The operative procedures employed for the relief of this condition have varied from curettage or removal of the entire gasserian ganglion to division of the sensory root proximal to the ganglion. Because of the numerous and well authenticated successes attained by neurological surgeons, we have come to believe that division of the sensory root of the nerve in question is the operation of choice in the treatment of trigeminal neuralgia. For this reason the surgical anatomy of the trigeminal nerve and of the gasserian ganglion is of especial interest and importance, particularly to the surgeon interested in neurological surgery.

To enable us to approach the gasserian ganglion and its sensory root with a feeling of confidence we have carefully examined 100 human skulls,—first, to establish certain landmarks in the middle fossa which will favor a rapid localization of the operative field; second, to point out the important relations of the gasserian ganglion and the sensory root; third, to determine the exact relations of the motor to the sensory root, in order to preserve the former as consistently as possible; and fourth, to find an explanation for those occasional cases in which paralysis of the facial nerve occurs following the operation.

HISTORY OF THE OPERATION

In 1886, at the suggestion of Ferrier, Sir Victor Horsley (1) and Macewen first attempted operative interference in cases of trigeminal neuralgia. Approach to the ganglion was made through the temporal bone, and the operative procedure was limited to simple division of the sensory root. Because of the high mortality following operation this method was soon abandoned. In 1890, Rose (2) excised the superior maxilla, trephined the base of the skull with the foramen ovale as a center, and curetted the ganglion away. At about the same time, Andrews of Chicago, among others, exposed and excised the ganglion through the pterygoid fossa. These radical operative steps were followed by an extremely high mortality. Two years later, Hartley (3) and Krause (4) simultaneously advocated an approach through the temporal bone by means of an omega-shaped flap of skin, muscle, periosteum, and bone. This procedure was known as the high temporal operation, in contradistinction to the method proposed first by Cushing (5), and later by Lexer (6), in which the line of incision was somewhat lower. These suggestions only concerned the means of reaching the gasserian ganglion to excise or avulse it.

Because of the high mortality resulting from avulsion of the ganglion, operative procedures were limited for a time to division of the peripheral branch involved. Such incom-

[1] Read before the Chicago Surgical Society, January 6, 1922.

plete measures were almost always followed by regeneration of the avulsed nerve and by attacks of pain in one of the remaining branches, so that further surgical procedures became necessary.

In 1898, after careful histopathological studies of the ganglia removed from cases of trigeminal neuralgia, and after animal experimentation combined with histological studies, Spiller (7) proposed simple division of the sensory root for the relief of the pain. Frazier (8) carried out this idea, and, in conjunction with Spiller, was able to show conclusively from an experimental and clinical standpoint that regeneration of a completely divided sensory root never occurs. In spite of this fact it is only within the past few years that simple division of the sensory root has been generally adopted. Even at the present time, avulsion of the root, instead of a clean division by the scalpel, is sometimes done.

At present, approach to the ganglion and sensory root is made through the temporal bone at the level suggested by Cushing and Lexer. The incision used by the authors is a longitudinal one extending upward for about 3 inches from the preglenoid tubercle on the zygoma. A simple trephine opening is made through the squamous portion of the temporal bone, and the opening enlarged with bone-biting forceps. The method of making a large flap of muscle, periosteum, and bone is quite unnecessary. The operative opening is enlarged downward as far as possible rather than upward, since the field is better exposed thereby and less retraction of the temporal lobe of the cerebrum is necessary. Upon raising the dura mater by sponge dissection from the floor of the middle cranial fossa, it may become necessary to identify several landmarks. These are (1) the foramen spinosum, through which the middle meningeal artery enters the cranial cavity; (2) the foramina ovale and rotundum containing the mandibular and maxillary divisions of the trigeminal nerve; and (3) the gasserian ganglion with its sensory root.

ANATOMICAL RELATIONS

The distance from the internal surface of the squamous portion of the temporal bone opposite the preglenoid tubercle to the foramen spinosum is 2.47 centimeters. This figure represents the average of those found in the skulls examined. The minimum distance between these points was 1.9 centimeters, and the maximum distance 3.4 centimeters. As will be seen from Table I, this distance, in 55 per cent of the skulls examined, ranged between 2.0 and 2.5 centimeters. The foramen spinosum in the majority of the specimens examined was in the most dependent portion of the fossa. In 4 per cent the foramen was continuous with the foramen ovale.

Marked grooves, running anteroposteriorly in the squamous portion of the temporal bone lateral to the foramen spinosum (Fig. 1), were present in 38 per cent of the skulls examined. These elongated depressions are produced by the cerebral convolutions of the temporal lobe and are of such depth as readily to be mistaken for the true operative field. The ridges bounding them, moreover, often produce difficulty in elevating the dura mater. The presence of such fossæ should be constantly borne in mind when search is being made for the middle meningeal artery.

Division of the middle meningeal artery is invariably necessary for a proper exposure of the ganglion, and, therefore, a knowledge of its location and common course is essential for the operator. As shown in Figure 2, we found six distinct variations in the course of the artery. In 41 per cent of the specimens examined the artery divided into a main anterior branch, which evidently was the direct continuation of the artery, and a smaller posterior branch, which coursed posteriorly, describing a slight curve above the site of the usual opening made in the bone for the exposure of the ganglion. In 36 per cent the anterior branch curved posteriorly for a variable distance before coursing forward, and the posterior branch was situated at a higher level on the temporal bone. In such a position the artery might very easily be injured by the trephine unless particular care were exercised. In the remaining specimens considerable variation was found. In 2 per cent the posterior branch was absent. Occasionally two posterior branches were present, and the

anterior branch divided before leaving the middle fossa. The danger of injury under such conditions would be increased proportionately with the number of branches. Bartlett (9) has also called attention to the variations in position and course of the middle meningeal artery, and his types resemble closely those found by us.

Ligation of the middle meningeal artery near the foramen is made more difficult, and elevation of the dura mater from the floor of the fossa is made more tedious by the presence, in 41 per cent of cases, of a bony prominence either overlying the foramen spinosum or just anterior to it (Fig. 1). Attention was called to this point by Cushing (5). The relative size of this prominence sometimes varies in opposite sides of the same skull; it may even be completely absent on one side

From a point on the inner surface of the skull opposite the preglenoid tubercle of the zygoma to the middle of the gasserian ganglion the distance in the specimens examined averaged 3.61 centimeters, the minimum being 2.8 centimeters and the maximum 4.4 centimeters. Reference to Table I shows that in 90 per cent of the skulls this figure varied between 3.0 and 4.0 centimeters. The foramen ovale, containing the mandibular division, was 3.14 centimeters distant from a point opposite the preglenoid tubercle. Over one-half of the foramina were between 2.0 and 3.0 centimeters away. The foramen rotundum and the maxillary division averaged 3.88 centimeters from the arbitrarily chosen point; the minimum was 3.0 centimeters and the maximum 4.5 centimeters. Eighty per cent of the foramina were between 3.5 and 4.5 centimeters distant.

The average bitemporal diameter of these skulls was 12.5 centimeters; 88 per cent of them were between 11.5 and 13.5 centimeters in diameter. The distance from the internal surface of the temporal bone opposite the preglenoid tubercle to the foramen spinosum was about one-sixth of the diameter of the skull; while the distances to the foramina ovale and rotundum and the gasserian ganglion were about one-fourth of the diameter. These facts held approximately true in each skull measured.

Fig. 1. Drawing of base of skull showing bony prominence overhanging foramen spinosum and marked lateral grooves in temporal bone.

Whereas Bartlett (9) used the foramen ovale as a localizing point, we believe the foramen spinosum is a more logical one, since it is the first landmark met with, and since it contains the highly important middle meningeal artery. Moreover, with increasing experience the surgeon will pass directly from the foramen spinosum to the sensory root without exposing the foramen ovale. Measuring from the lateral edge of the foramen spinosum, we found the gasserian ganglion to be 1.66 centimeters distant, at an angle of 15 degrees occipitad from a transverse diameter drawn through the foramen spinosum. As will be seen by Table II, in 76 per cent the angle varied between 5 and 20 degrees. We found the foramen ovale to lie 7 millimeters from the foramen spinosum at an angle of 22 degrees frontad from a transverse diameter through the foramen spinosum. In 82 per cent the angle was between 15 and 30 degrees. The foramen rotundum was 2.27 centimeters, away at an angle of 36 degrees. In 81 per cent the angle was between 30 and 45 degrees. Figure 3 illustrates these anatomical relations.

We found the gasserian ganglion invariably to lie immediately upon the foramen lacerum, which contains the internal carotid artery with its plexus of veins and sympathetic

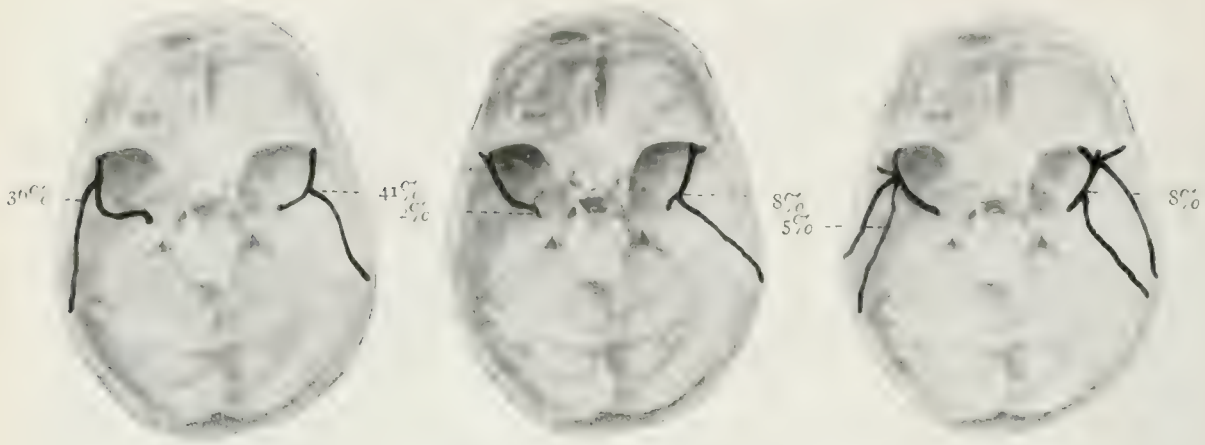

Fig. 2. Types of middle meningeal arteries found in 100 skulls.

nerve fibers (Fig. 4). Separating the carotid artery from the lower surface of the ganglion there is present a fibrous membrane (Fig 5) which varies in its strength and thickness. In 40 per cent of our specimens this membrane was very thin and could easily be penetrated in attempting to raise the ganglion from its bed. In the other cases the membrane was fairly thick; in some it was replaced by a thin shell of bone.

In the specimens examined the gasserian ganglion measured 1.0 centimeter in its mediolateral diameter and 0.8 centimeter in its anteroposterior diameter. Hutchinson (10) gives the size of the ganglion as 1.4 to 2.2 centimeters by 0.4 centimeter. The ganglion is in contact anteriorly, near the ophthalmic division of the nerve, with the cavernous sinus, and at its center it is 6 millimeters distant from the lateral wall of this sinus. Although, at present, injury of the sinus by experienced surgeons is comparatively rare, its close vicinity to the gasserian ganglion should be kept in mind.

RELATIONS OF THE MOTOR ROOT

The loss of function in the movements of the jaw resulting from paralysis of the masseter and pterygoid muscles, due to division of the motor root, is perhaps not sufficient in itself to require preservation of this portion of the nerve. The patient does not suffer a noticeable discomfort in approximation of the jaw, yet there is an asymmetry which can easily be seen. In addition, the marked atrophy which follows paralysis of the temporal muscle, and the subsequent depression above the zygoma are undesirable features. All surgeons will agree that if it is possible to preserve the motor root of the nerve while dividing the sensory root, one serious objection in the operation will have been removed, particularly in the minds of those who have not been able to observe for themselves the prompt and satisfactory recovery, and the immediate and complete relief from pain which invariably follow section of the sensory root.

Opinion has varied widely as to the exact position of the portio minor and as to whether or not its preservation is possible as a routine procedure. Figures of the exact position of the motor root with relation to the portio major found in current textbooks of anatomy differ somewhat, and are rather misleading. We examined very carefully the relation of the sensory and motor roots in 60 specimens which had been previously preserved in the usual dissecting room manner. Contrary to the usual belief, we found that the two roots could be separated with ease, especially where the motor root lay medial to the sensory root and slightly superior to it. We found the portio minor to be somewhat whiter and more compact than the network of fibers which form the ganglion and merge into the sensory root, and about the size of the lead of a pencil. It invariably left the pons medial

TABLE I

From the internal surface of the temporal bone to the:

a. Foramen spinosum:

1.5 cm. to 2.0 cm. in	10 per cent
2.0 cm. to 2.5 cm. in	55 per cent
2.5 cm. to 3.0 cm. in	28 per cent
3.0 cm. to 3.5 cm. in	7 per cent

b. Gasserian ganglion:

2.5 cm. to 3.0 cm. in	3 per cent
3.0 cm. to 3.5 cm. in	40 per cent
3.5 cm. to 4.0 cm. in	50 per cent
4.0 cm. to 4.5 cm. in	7 per cent

c. Foramen ovale:

2.0 cm. to 2.5 cm. in	10 per cent
2.5 cm. to 3.0 cm. in	46 per cent
3.0 cm. to 3.5 cm. in	30 per cent
3.5 cm. to 4.0 cm. in	14 per cent

d. Foramen rotundum:

3.0 cm. to 3.5 cm. in	18 per cent
3.5 cm. to 4.0 cm. in	47 per cent
4.0 cm. to 4.5 cm. in	32 per cent
4.5 cm. to 5.0 cm. in	3 per cent

TABLE II

From the foramen spinosum to:

a. Gasserian ganglion at an angle of:

5 degrees to 10 degrees in	21 per cent
10 degrees to 15 degrees in	30 per cent
15 degrees to 20 degrees in	25 per cent
20 degrees to 25 degrees in	11 per cent
25 degrees to 30 degrees in	6 per cent
30 degrees to 35 degrees in	7 per cent

b. Foramen ovale at an angle of:

40 degrees to 35 degrees in	2 per cent
35 degrees to 30 degrees in	9 per cent
30 degrees to 25 degrees in	28 per cent
25 degrees to 20 degrees in	30 per cent
20 degrees to 15 degrees in	24 per cent
15 degrees to 10 degrees in	7 per cent

c. Foramen rotundum at an angle of:

50 degrees to 45 degrees in	15 per cent
45 degrees to 40 degrees in	22 per cent
40 degrees to 35 degrees in	39 per cent
35 degrees to 30 degrees in	20 per cent
30 degrees to 25 degrees in	3 per cent
25 degrees to 20 degrees in	1 per cent

and somewhat superior to the portio major. It turned about the medial side of the sensory root and passed beneath the ganglion, coursing somewhat obliquely across its under surface to the medial side of the mandibular division, with which it became incorporated after entering the foramen ovale. This description agrees with illustrations found in Spaltheholz (11) and Ranson (12), and with Pegler's map scheme of the trigeminal nerve

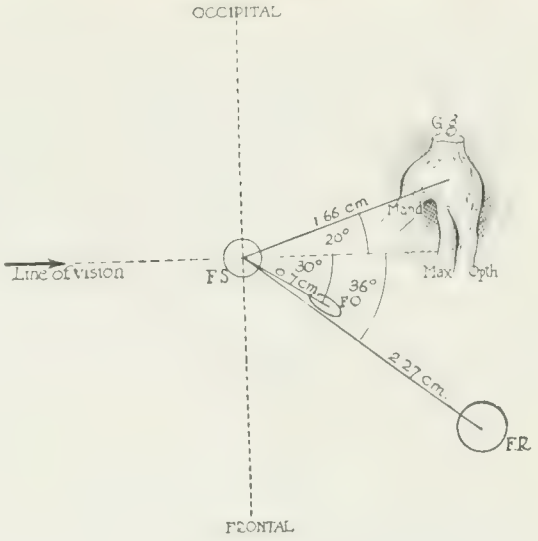

Fig. 3. Diagram showing anatomical relations of foramen spinosum to the gasserian ganglion, foramen ovale, and foramen rotundum in a typical case.

(13). Figures 6 and 7 show the size and relations of the motor root as we found them.

Tiffany (14) was the first to call attention to the desirability of preserving the motor root, and believed that it could be saved. Keen (7) expressed the opinion that it could not be preserved from an operative point of view, although it is well to note that he was discussing resection of the ganglion. Cushing (15), in 1905, stated that it was an anatomic impossibility to separate the underlying motor root from the lower surface of the ganglion. Hutchinson (10) believes that the motor root can be isolated centrally from the ganglion only when it lies medial and superior to the sensory root. Frazier (16) very recently has described his method of isolating the motor root, and identifying it by electrical stimulation. He reports that the percentage of cases in which he saves the root is increasing, and his successful results are more than encouraging. We have been able to preserve the motor root and separate it from the sensory root centralward from the ganglion in an increasing proportion of our cases. Its different texture and its distinctive pearl grey color help in the identification. Proof of isolation can be made by stimulation with an electrode, whereupon crunching movements

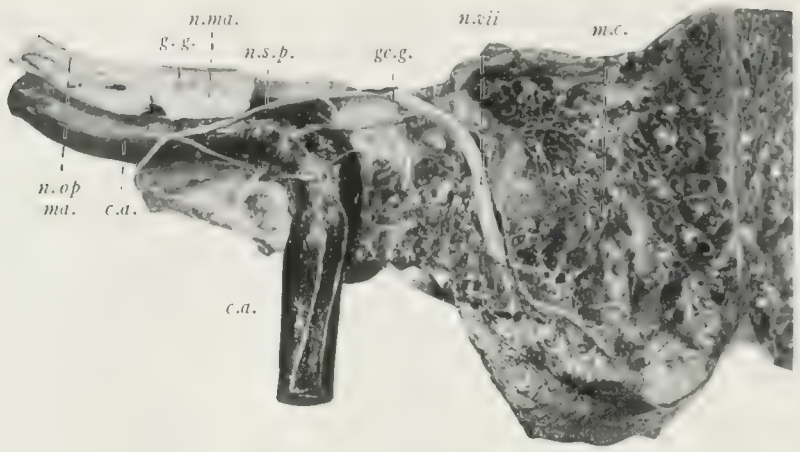

Fig 4. Photograph of a model showing relation of gasserian ganglion and the internal carotid artery. *g. g.*, Gasserian ganglion; *n.ma.*, mandibular nerve; *n.s.p.*, superficial petrosal nerve; *ge.g.*, geniculate ganglion; *n.vii.* facial nerve; *m.c.*, mastoid cells; *n. op. ma.*, ophthalmic and maxillary nerves; *c.a.*, carotid artery.

of the jaw on the stimulated side and contraction of the temporal muscle are produced. If the motor root cannot be isolated without undue trauma we feel that it should be sacrificed with the sensory portion.

PARALYSIS OF THE FACIAL NERVE

Partial and transitory paralyses of the facial nerve occasionally occur as an untoward result of operations for the relief of trigeminal neuralgia, although we believe, not so frequently since simple division rather than avulsion of the sensory root has been carried out. Clinically the course resembles that of a Bell's palsy and the symptoms gradually disappear. No adequate explanation of this occurrence has been given.

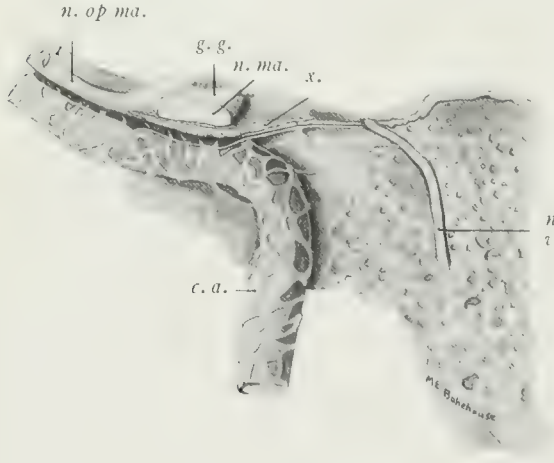

Fig. 5. Drawing, illustrating the membrane which lies between the carotid artery and the gasserian ganglion. *n.op.ma.*, Ophthalmic and maxillary divisions; *g.g.*, gasserian ganglion; *n. ma.*, mandibular division; *x*, membrane between gasserian ganglion and carotid artery; *n.vii*, facial nerve; *c.a.*, carotid artery and venous plexus.

Hutchinson (10) suggested the close relationship of the seventh and fifth cranial nerves within the pons as an explanation for this occurrence. This argument is weakened by the occurrence of the palsy in cases of simple division of the sensory root, where the likelihood of injury of the pons is negligible. It is not difficult to believe that injury of the pons and of the nucleus of the seventh nerve might occur when the root is forcibly avulsed, but the complete involvement of the facial muscles indicative of an infranuclear lesion, the subsequent disappearance of symptoms, the lack of involvement of other cranial nuclei, and the unilateral localization of the symptoms speak very strongly against a supranuclear or nuclear lesion.

To show the concomitant results within the pons of dividing and avulsing the sensory root, we operated upon four cats, dividing the root in two cases and forcibly avulsing it in the others. The animals were killed at the end of

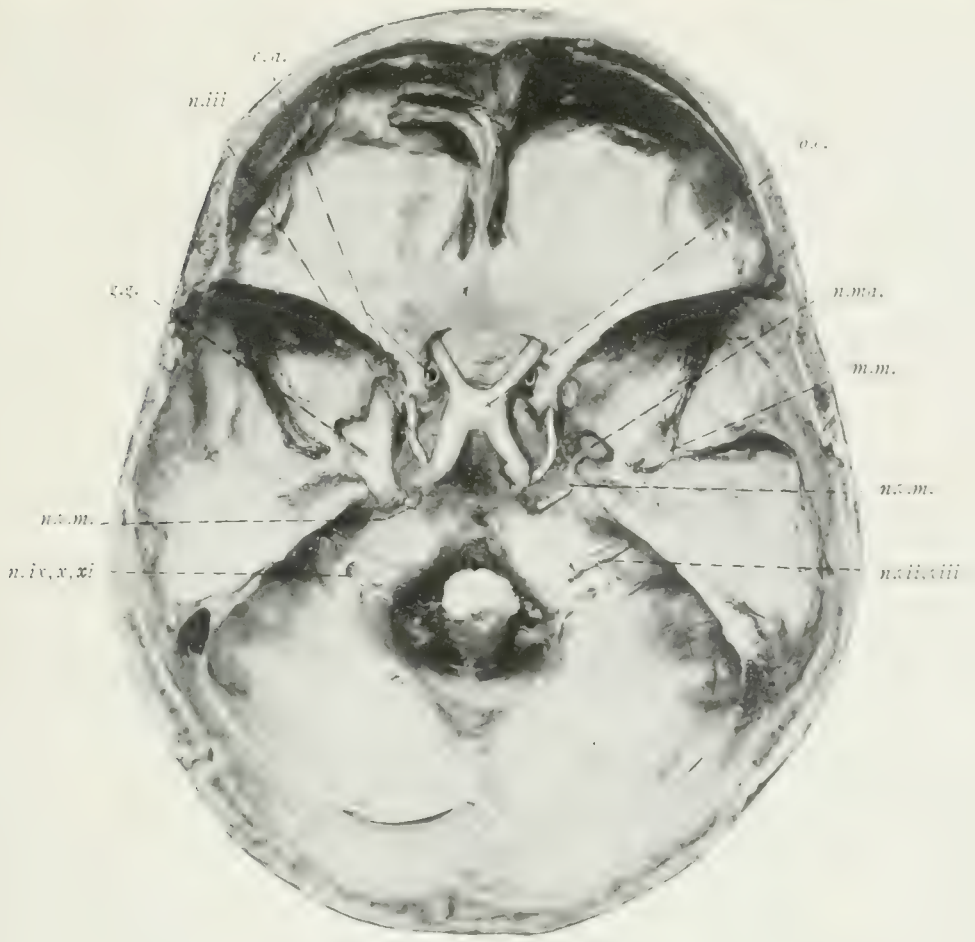

Fig. 6. Photograph of a dissection of the base of a skull showing the size and relations of the motor and sensory roots of the trigeminal nerve. *c.a.*, Carotid artery and cavernous sinus; *n.iii.*, oculomotor nerve; *g.g.*, gasserian ganglion; *n.ix,x,xi*, cranial nerves; *o.c.*, optic chiasm; *n.ma.*, mandibular division, trigeminal nerve; *m.m.*, middle meningeal artery; *n.v.m.*, motor root, trigeminal nerve; *n.vii* and *viii*, cranial nerves.

two weeks, the pons was carefully removed, and the material stained by the Marchi method. Macroscopically, the roots which were cut with a scalpel showed a definite line of division and were intact at the point of exit from the pons. The avulsed roots were ragged and irregularly torn at a point about 3 millimeters distant from the edge of the pons. Grossly, no disturbance in the substance of the pons could be seen. In all probability the opening into the cavum meckelii, through which the roots pass, acted as a barrier when the nerves were picked up and pulled upon, so that a direct force could not be exerted. Clinically, the animals in which the root was avulsed showed more marked conjunctival symptoms. In both types, sensation was demonstrated to be completely lost over the distribution of the trigeminal. Microscopically, both types showed in the pons and in the medulla the same degenerative changes, involving the sensory nucleus and spinal tract of the nerve. As far as could be determined, there were no degenerative changes in the seventh nerve in its course within the pons.

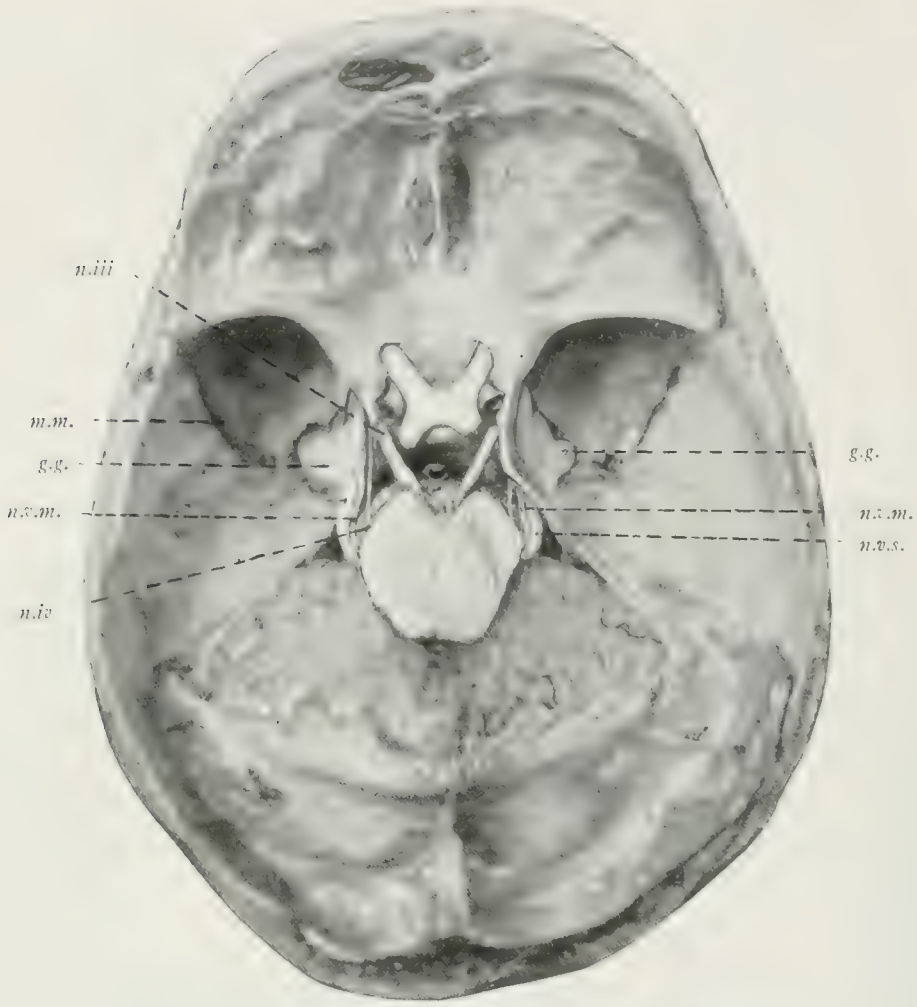

Fig. 7. Photograph of a dissection of the base of a skull with the cerebellum and pons in position, illustrating the relations of the motor and sensory divisions of the trigeminal nerve. *n.iii*, oculomotor nerve; *m.m.* middle meningeal artery; *g.g.*, gasserian ganglion; *n.v.m.*, motor root, trigeminal nerve; *n.iv*, trochlear nerve; *n.v.s.*, sensory root, trigeminal nerve.

Adson (17) has not observed any cases of facial palsy following division of the sensory root. He avulsed the sensory root from the pons upon postmortem material, and found gross evidences of considerable trauma at the point of exit. He believes also that as a result of detachment of the dura mater from the petrous portion of the temporal bone, profuse bleeding may occur, and that the blood, entering the facial canal through several small bony openings, may cause a facial palsy.

It is true that detachment of the dura mater from the floor of the middle fossa, and from the surface of the ganglion, is often accompanied by rather profuse bleeding. As can be seen from Figure 4, the facial nerve lies at some distance from the site of operation making such involvement difficult. The fact that oozing is constantly present during each operation, and that the palsy occurs relatively infrequently, seems to us an important point.

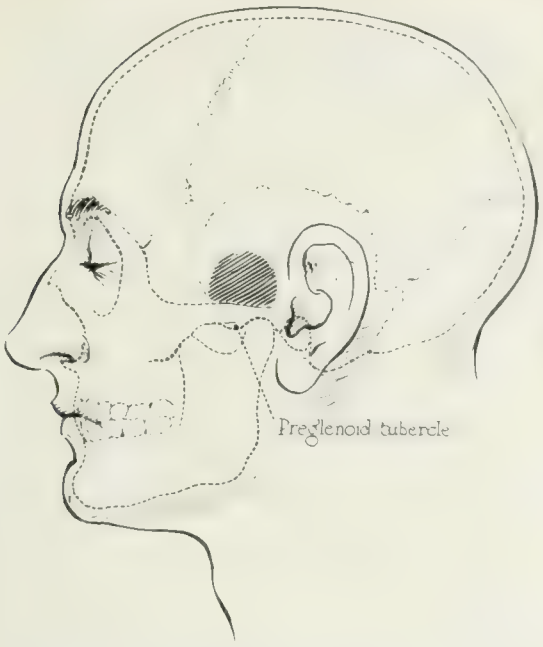

Fig. 8. Diagram showing the preglenoid tubercle of the zygoma and the site of operation.

That the location of the irritative lesion is in the facial canal, rather than at the internal auditory meatus, is suggested by the fact that the acoustic nerve is not involved. By referring to Figure 4, the relation of the greater superficial petrosal nerve to the petrous portion of the temporal bone will be seen. It is not unreasonable to assume, as has been suggested by Taylor, that this nerve may be pulled upon in elevating the dura mater from the petrous portion of the temporal bone, and the traction be communicated to the seventh nerve near the geniculate ganglion in such a manner as to give rise to injury to this nerve, although a simple infective origin cannot be eliminated.

CONCLUSIONS

In conclusion we wish to emphasize the following points:

1. The distance from a point upon the inner surface of the squamous portion of the temporal bone opposite the preglenoid tubercle to the foramen spinosum was found to average 2.47 centimeters.

Fig. 9. Photograph of patient following resection of the sensory root of the trigeminal, with preservation of the motor root.

2. There are six distinct types of middle meningeal arteries, the larger percentage of which give off single anterior and posterior branches.

3. The distances from the foramen spinosum to the gasserian ganglion, foramen ovale, and foramen rotundum, respectively, are 1.66 centimeters at an angle of 20 degrees occipitad from a transverse diameter through the foramen spinosum; 0.7 centimeter at an angle of 30 degrees frontad from the transverse diameter; and 2.27 centimeters at an angle of 36 degrees frontad from the transverse diameter.

4. In 41 per cent of cases a marked bony prominence overhangs the foramen spinosum, which leads to difficulty in elevating the dura mater and ligating the middle meningeal artery. Further, in 38 per cent marked lateral grooves are present which may lead to difficulty in localization of the operative field.

5. An attempt should be made to save the motor root, which lies medial to and somewhat superior to the sensory root centralward from the ganglion.

6. A thin membrane lies between the gasserian ganglion and the carotid artery in 40 per cent of the skulls examined.

7. The cause of the paralysis of the seventh nerve which infrequently occurs cannot as yet be definitely stated.

We wish to thank Dr. S. W. Ranson of the Anatomy Department of the Northwestern University Medical School for his kindness in placing material for study at our disposal.

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SECONDARY PAROTITIS

By FRANK S. LYNN, M.D., F.A.C.S., Baltimore

DURING 1920, in a very short period, 3 cases of secondary parotitis developed in the surgical division of the University Hospital. During that year 947 intra-abdominal and pelvic operations were done. Prior to that time this complication had not made its appearance in our clinic in several years.

Before taking up the discussion of this condition, brief synopses of these cases are herewith given:

Case 1. Mrs. B., age 61, No. 19189, admitted February 25, 1920; operation, February 28, 1920—panhysterectomy. Diagnosis: carcinoma of cervix. Pathological diagnosis: squamous-celled carcinoma of cervix.

On March 2, 1920, 2 days following operation, the patient, after considerable nausea and vomiting, developed a left parotitis. This continued and finally went on to resolution without incision being necessary. On March 10, 1920, a right parotitis developed. This likewise went on to resolution. In this case ice applications were used.

Case 2. G. A. W., age 28, male, No. 19421, admitted March 15, 1920; operation, March 22, 1920—right nephrectomy. Diagnosis: nephrolithiasis with pylonephritis (right) May 18, 1920.

On March 31, 1920, 9 days after the operation, patient developed a right parotitis. Application of ice was used. Suppuration took place, parotid was incised. After this patient had an uneventful recovery.

Case 3. A. C., age 10, male, No. 21459, admitted August 13, 1920. Diagnosis: appendicitis, with diffuse peritonitis. Operation: for abdomical condition, none.

Taken sick August 7, brought to the hospital 6 days later, condition such that operation was considered out of the question. With ice to abdomen, the Fowler's position, Murphy's proctoclysis, and infusions of salt solution his general and abdominal conditions improved.

On August 16, right parotitis developed. On August 17, left parotitis developed. Cold applications were used. August 24, right parotid was incised. August 27, left parotid was incised. Patient began to improve and was discharged September 24, 1920. Improved.

This condition, while not particularly common, is of sufficient frequency and interest to merit an occasional study and review of the literature. It is a phenomenon which has been associated not only in surgical procedures but has been frequently met with when a strictly medical régime has been carried out. In reviewing the literature it is quite interesting to note the gradual elimination of factors formerly thought to play a part in the production of this condition.

In 1886 Stephen Paget, in discussing this subject, classified parotitis under four heads: (1) mumps; (2) injury; (3) debilitating diseases, such as typhoid and typhus; (4) when the primary lesion is an abdominal condition free from septicæmia and pyæmia.

From his observation of the fourth class of cases he concluded that the parotid was related to the peritoneum; that it was also related to the generative organs; that an abdominal or pelvic lesion may be followed by parotitis without pyæmia; that such a parotitis, if it occurs late in a patient, not exhausted by the primary disease, and with healthy kidneys, is usually followed by recovery. According to Paget this relationship of parotid to abdomen the older writers called "sympathy." One year later (1887) Paget had collected 101 cases as follows:

Ten due to injury of the urinary tract; 18 due to injury of the alimentary tract; 23 due to injury of the abdominal wall, peritoneum or pelvic wall; 50 due to injury, or disease, or temporary derangement of the generative organs.

It will be noted from Paget's table that the majority of the older cases reported were overwhelmingly associated with ovariotomy, and this strengthened the belief that there was a sympathetic connection with the parotid. But now we know it is not any more common in pelvic conditions than in other intra-abdominal processes.

The observation has been correctly made that formerly most abdominal surgery consisted of ovariotomies. Paget based his opinion that secondary parotitis was sympathetic, on the occurrence of changes in the generative organs during mumps. This, as an etiological factor, has long since been discarded.

The literature presents many interesting phases of this condition and before taking up the etiology and pathology we shall touch briefly some interesting cases.

Numerous cases are reported in connection with appendicitis, by Barlow, Elder, Bunts, Thomas, Bowe, Frank, and Jones. The latter's case being most interesting it will be reviewed briefly.

Patient with recurrent appendicitis. First attack 1897, appendiceal abscess, opened and drained, followed by bilateral parotitis. One year later another appendiceal abscess, opened and drained, again bilateral parotitis. The following year there was another attack of appendicitis. This time abscess was opened, drained and the appendix removed, again a bilateral parotitis.

We also find this condition not infrequently during the treatment of gastric and duodenal ulcers, both by surgical and non-surgical procedures, and in treating them in a medical way some interesting facts are revealed.

Rolleston and Oliver studied this condition in the medical treatment of 1000 cases at St. George's Hospital. In the treatment of 530 cases food, water or both were given by mouth, and of these two cases, or 0.4 per cent developed secondary parotitis. Of the remaining 470 cases, all treated by rectal feeding, 21 cases, or 4.5 per cent, developed this complication. So we see in this series, parotitis was over 10 times more frequent when oral starvation was practiced than when food or drink was allowed by mouth.

Many instances are also found of the condition following various operative procedures on the stomach.

Harkin reports parotitis in a woman, age 43 years, as the first symptom of three successive pregnancies. None followed by suppuration.

The cause of secondary parotitis has occasioned a good deal of discussion. At first it was regarded as a variety of mumps, but there is a marked difference; primary parotitis is infectious with no tendency to suppurate, secondary parotitis is non-infectious, and often goes on to suppuration. Heat degeneration as a cause, advanced by Liebermeister, in cases of hyperpyrexia, had few followers and has been discarded. Dalche, in his case of climateric parotitis, concludes by observing that "one thinks more readily that it arose primarily from vasomotor disturbances aroused perhaps by a genital autointoxication (Dyball)." Toxins as a cause are no longer regarded seriously and in fact have been eliminated.

The sympathetic theory was advanced by Stephen Paget at a time when most abdominal operations were on the generative organs of the female. At that time infections were rife, and these cases of secondary parotitis were most likely due to infections, which brings us to the next factor.

Pyæmia or embolism: This was the first causative factor to receive a very general acceptance, but it is even to this day denied by some. They raise the point that secondary parotitis has occurred with no infection, and again where infection has been present there has been no evidence of thrombosis or septic emboli. But undoubtedly some cases are metastatic in origin.

Lastly we come to the duct-infection theory first advanced in 1889 by Hanau and Pilliet. They were the first to suggest the possibility of infectious organisms traveling up the duct to the gland. To justify their opinion they called attention to the pathological findings, namely, inflammation around the ducts and then spreading to the perilobular tissue; whereas if due to emboli the inflammation would first appear perivascular. This was substantiated by the bacteriological findings of Girode, who found the organisms mostly occurring to be the staphylococcus, pneumococcus, pneumobacillus, typhoid bacillus, colon bacillus, and the streptococcus in order of frequency.

In cases of gastric and duodenal ulcers, Hone and Barton attached more importance to antecedent hæmatemesis than oral starvation as a factor in the production of secondary parotitis. This might be likely only in so far as it leads to treatment by oral starvation there being no evidence that parotitis depends on the occurrence in the parotid gland of thrombi, such as might be favored by a posthæmorrhagic leucocytosis.

Dyball, on the other hand, says that "one of the strongest arguments against this theory

of 'buccal dryness' is the fact that the submaxillary and sublingual glands are practically never affected. Whereas one would expect them as frequently as the parotids."

Against this we might observe that the parotid is a serous gland, the submaxillary and sublingual are mucous glands and secrete mucin.

William Stuart-Low has demonstrated the inhibitory influence of mucin on bacterial growth. He showed that mucin has a retarding influence on bacterial growth, that sterilized solutions containing mucin remained sterile for sometime on exposure to air, and that bacteria ceased to grow in culture media when mixed with mucin. He says: "It is evident, therefore, that mucin fulfills a potent part in the defense of the body against bacterial attack."

The parotid contains lymph glands, the other salivary glands do not. The presence of these favors the collection of infectious agents and the setting up of an inflammatory process.

Before dismissing the question of cause there is one factor called attention to by Deaver, namely "traumatism—the result either of direct pressure on the parotid gland, or the forcible manipulation of the jaw by the anæsthetist." But how many times have we seen cases in which the administration of the anæsthetic was difficult and it was necessary forcibly to hold the jaw and yet this condition did not develop; and again we have seen this condition arise after a perfectly smooth anæsthetic. At the City Hospital, many of the patients were alcoholics, the anæsthetic in a great many cases difficult, and the occurrence of this condition practically nil.

Inquiries made by Fisher show that traumatism of the bony or soft structures of the face have had little or nothing to do with the production of the condition. He says: "The results of such inquiries have been negligible as to infectious parotitis." Our experiences bear out this conclusion. If it has any bearing it is only a minor rôle. For why is it that this complication is practically confined to lesions and operations within the abdomen?

According to Blair suppuration usually takes place in 3 or 4 days, all symptoms being increased. Dyball finds that 33⅓ per cent of the cases are bilateral. When this condition is bilateral there is usually an interval of 2 days before its occurrence on the second side. The enclosure of the pus might rupture and the latter discharge through the external ear, or it might force its way to the sternocleidomastoid muscle and travel downward to the supraclavicular and mediastinal regions. Retropharyngeal abscesses have been known to form secondarily. The gland might become gangrenous.

Wagner claims the mortality of these cases is 30 per cent.

Fenwick, in the treatment of ulcer by oral starvation, formerly had a large number of cases develop suppurative parotitis. He tried various mouth washes without success. He then resorted to the giving of agents that would promote salivary secretion, at the same time not stimulating peristalsis of stomach or intestines. After trying this plan he treated more than 300 cases by rectal feeding without a case of parotitis. So much for attempts at prevention. When the condition does arise, the use of ice is recommended (Blair) and when suppuration does occur, as it usually does in 3 or 4 days, radical treatment by the incision of Blair, Lilienthal, or Cope are recommended.

In this, one should not wait for fluctuation, but he should be governed by the increase of symptoms.

CONCLUSIONS

1. More attention should be paid to the condition of the mouths of our patients, before and after operation. Following operations some mild salivary stimulant should be given to keep the ducts clean.

2. The reason the sublingual and submaxillary glands are practically immune is because they are mucous glands, mucin inhibiting bacterial growth.

3. Furthermore the parotid is the only salivary gland containing lymph glands. These favor the collection of inflammatory agents.

4. There are two main sources of infection: viz. (1) through the blood or lymph stream, (2) by way of Stenson's duct.

5. It is my opinion that the infection of the parotid in the cases herein reported were oral, in view of the fact that in every instance oral starvation was necessary for some days. Surgical treatment is justified if symptoms do not subside by the third or fourth day.

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PERFORATED ULCERS OF THE DUODENUM[1]

A Report of Fifteen Consecutive Cases

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In the *Annals of Surgery*, November 1920, Farr, in his article on "Perforated Gastric and Duodenal Ulcers" states in conclusion: "Early diagnosis and simple closure of the perforation will result in cure in a very large proportion of cases. Gastro-enterostomy should be reserved for the few who may need it later." Directly following this article is one by Lewisohn entitled: "Persistence of Pyloric and Duodenal Ulcers following Simple Closure of an Acute Perforation." Deaver in his review of 55 consecutive cases of perforated gastric and duodenal ulcers, summarizes as follows: "Accumulating statistics and more accurate follow-up records are dispelling the fallacy that perforation cures ulcer and tend to show that primary gastro-enterostomy lessens the likelihood of future ulcer symptoms and complications." On the following page of this same journal[2], one reads that Smithies, out of 226 cases of gastro-enterostomy operations for gastric and duodenal ulcer traced, reports that only 57, 20.9 per cent, were clinically free of complaints. From such paradoxical statements it is quite evident that the therapy for gastric and duodenal ulcers is far from a satisfactory standardization.

The problem of duodenal ulcer differs in some respects from that of gastric ulcer. Therefore, it would seem that greater progress might result from the diligent efforts which are everywhere being made to improve the treatment of ulcers if the results of gastric and duodenal surgery were reported separately. Most papers are combined reports and consequently are at times, confusing. The fifteen cases comprising this study are perforated ulcers of the duodenum and the discussion will pertain to the subject in question except when reference is made to gastric ulcer.

In this most dramatic of acute abdominal crises, operation within the first 12 hours with simple closure of the perforation will terminate in recovery in the great majority of cases. The problem is the future welfare of the patient after his postsurgical convalescence. The question of latent malignancy in the ulcer-bearing area is negligible in contradistinction

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to gastric ulcer where there is a 20 per cent potential cancer menace. Is the ulcer healed by simple closure, will it stay healed, and will the patient remain free from symptoms? There is the crux of the question. Before attempting an answer to this, a proper conception of the salient anatomy and physiology of the duodenum must be emphasized in order adequately to appreciate the changes that occur in both from the pathogenesis of ulcer. The cardia and the first part of the duodenum are fixed points of the stomach. This viscus when empty lies transversely in the upper abdomen, and when filled assumes a more vertical plane due to a marked descent of the prepyloric portion. Therefore when filled, the weight-bearing area is principally in the distal portion of the pylorus and the first portion of the duodenum, especially the latter, producing considerable traction on this area. Moreover, this particular area, i.e., the pylorus and the first portion of the duodenum (and distal portion of the lesser curvature) has a scantier blood supply than the stomach proper. Furthermore, in this subvascularized area the mucosa is intimately attached to the muscle layers with the formation of rugæ. Thus no allowance is made for dilatation and contraction and the area is predisposed to traction anæmia. This traction ischæmia lasts for about 2 hours after eating, and may be a potent predisposing factor for selective embolic infections, thrombosis, or tissue digestion. At all events this traction anæmia may have a definite effect upon the healing of ulcers and a practical bearing on the postoperative care. (If the foot of the patient's bed be elevated 6 inches, gravity will overcome this traction of the pars pylorica and the duodenum will receive its full blood supply.) Normally when food enters the stomach it is subjected to a thorough liquefaction and mixing with gastric juice. Chymification is complete before the sphincter relaxes. Thus the motile powers of the stomach exhibit a proper balance between propulsion and retention. (There is probably a segmental activity of each curvature.) This motility mechanism is badly damaged by gastro-enterostomy. In normal digestion the acid chyme entering the duodenum transforms the prosecretin into secretin and the pancreatic secretion ensues. The duodenum by its churning movements intimately mixes the chymified food with the bile and pancreatic ferments before it is passed onward into the jejunum. In gastro-enterostomized patients a revolutionary change in the physiology of digestion occurs. Improperly prepared gastric contents enter the jejunum which in turn is called upon to assume the duodenal function for which physiologically it is unsuited. That some have pain, vomiting, and diarrhœa, and other dyspeptic symptoms is small wonder. That many thrive despite their altered physiology merely accentuates the remarkable adaptability of human economy. It should be emphasized that gastro-enterostomy performed for scar tissue obstruction of the pyloroduodenum is in the majority of cases a satisfactory procedure. In such cases of obstruction there has pre-existed for sometime an altered function both motile and secretory, chiefly of the stomach, to a less degree of the duodenum. In these cases of disturbed function, a short-circuiting is the lesser of two evils and nature's adaptability again functions. Conversely, it is well known that in the absence of true pyloroduodenal stenosis, gastrojejunostomy is often fraught with future disaster. For several months the patient is likely to be comparatively free from symptoms but the late results may be most disappointing. This point is well emphasized by Smithies. The cardinal indication for gastrojejunostomy would, therefore, be a true stenosis. It should also be remembered that nature overcomes many apparent stenoses.

The writer is of the impression that should the diameter of the duodenum be reduced not more than one-half due to the infolding of a perforated ulcer, no stenosis will result. (*Vide*, Cases 3 and 7.)

Pathology. Of the well-established, easily demonstrable chronic ulcer we have ample knowledge; of the so-called acute ulcer, the erosion, the ulcerating lesions which recover and disappear under medical treatment our knowledge is meager. It is highly probable that from time to time small defects occur in the gastric and duodenal mucosa, with or

without symptoms and that these spontaneously disappear. Defects of greater magnitude, true ulcers with typical clinical findings sometimes completely disappear under medical treatment. The so-called remissions and exacerbations in these histories may be explained upon the ground of recurring new ulcers. Once the lesion has become a well-established, indurated type, the pathological process is prone to become progressive with little or no remission of symptoms. These, the true surgical ulcers, present in general five types: (1) the large ulcer with an abundance of scar-tissue induration, which encroaches upon the lumen of the duodenum and usually presents more or less extensive extrinsic adhesions; (2) medium-sized ulcers with moderate scar-tissue infiltration, without narrowing of the lumen; (3) the small ulcer with a non-indurated or slightly indurated base; (4) the acute necrotic type; (5) multiple ulcers including the so-called kissing type. Perforation may occur in any type and as the problems in pathology are varied, so also are the indications for surgical repair. To state dogmatically that suture with posterior gastro-enterostomy should be employed in all cases is as illogical as to maintain that simple closure will always suffice. Good surgery should aim to cure the patient of this pathology with the least insult to anatomical and physiological function. Clinically the majority of acute perforations of the duodenum occur in ulcers of group 2, 3, and 4 types. These lesions present a remarkable monotony. They are single, simple, round, slightly indurated ulcers, 1 to 2 centimeters in diameter occuring in the suprapapillary portion of the duodenum (450 to 1) and in the vast majority of cases in the first 1½ inches on its anterior or superior surface. Those occurring at the pyloro-duodenal junction are probably for the most part duodenal. In these the pyloric veins are often obliterated. Much less than half present adhesions to neighboring structures: gall bladder, liver, colon, stomach, or omentum. It is the writer's impression that most ulcers that perforate suddenly are non-adherent to adjacent viscera, and that the adhesions when present are of recent origin. Disease of the appendix and gall bladder is frequently concomitant. The perforation is usually 2 to 5 millimeters in diameter, a typically punched out hole in the crater of the ulcer. If one carefully examines such perforation it will be noted that usually the entire ulcerating portion has been extruded as the result of embolism or thrombosis. The induration remaining is the protective zone and accounts for the rapid healing after closure. The writer is convinced that in some cases this induration is soon absorbed and the duodenum is restored to its normal condition without any macroscopic evidence of previous disease. (*Vide* Cases 3 and 9.)

Thus one seems justified in stating that lesions of types, 2, 3 and 4, which comprise the majority of perforated duodenal ulcers are best treated by simple closure.

Type 1. The large ulcer with an abundance of scar-tissue induration which encroaches upon the lumen of the duodenum and which usually is adherent to neighboring organs presents a different pathology and demands appropriate surgical therapy. Such lesions, prior to perforation have produced a partial stenosis thereby resulting in a change in the motility and secretory functions of the stomach. The closure of these ulcers after perforation usually produces a real rather than an apparent obstruction. Consequently they present the cardinal indications for gastro-enterostomy namely, stenosis plus a pre-existing altered gastric function. (Perhaps some form of pyloro-plasty of the Finney or Horsley type may prove more efficacious in the therapy of these types.) Furthermore, simple closure in this type seldom results in permanent cure, and the relapses after such a closure have helped to popularize primary gastro-enterostomy for all types. These ulcers closely simulate the calloused gastric types which so often fare badly after simple suture. The treatment of the multiple ulcer type must be governed by the pathological problem at hand.

From the above mentioned pathology, it will be noted that for practical purposes perforated ulcers of the duodenum conform themselves to one of two types. First, the *soft lesions*—the more common type, characterized, (a) by their relatively smaller size,

(b) by their superficial extent, (c) by their failure to penetrate deeply prior to the embolic or thrombotic phenomenon which results in perforation, (d) by the absence of dense induration, and (e) by lack of adhesions and encroachment upon neighboring structures. Second, the *calloused type*, characterized (a) by their large size, (b) by their deep penetration, (c) by their dense induration, (d) by their firm adhesions to neighboring structures, and (e) by their tendency to produce mechanical complications. The writer believes that simple closure by inversion with fine chromic catgut will cure the *vast* majority of the first group whereas the calloused types require in addition a primary gastro-enterostomy (or perhaps some form of pyloroplasty). The successes and failures in this series are in accord with these general principles.

The diagnosis of perforation is readily made in most all cases. The anamnesis of previous indigestion, the suddenness of onset, the agonizing pain, constant in character in contradistinction to the colic-like of appendicitis, cholecystitis, intestinal obstruction or renal colic, the vast extent and degree of rigidity and tenderness so soon after onset, the comparatively slow pulse, slight or no febrile reaction—is a familar picture. A few points are worthy of emphasis: Vomiting occured in less than half of the cases in this series (7 cases). Rectal examination may elicit extreme tenderness soon after perforation—much earlier than in appendicitis. The symptom of shock has been overemphasized. In this series but four were in any degree of shock. Apparently shock, when present, occurs soon after perforation and is transitory. It should also be mentioned that in stout individuals there is only slight rigidity. Also in the transitional period passing on to true peritonitis, there is a free interval when the pain is ameliorated. One patient (Case 3) seen 18 hours after perforation sat up in bed exclaiming, he felt quite well. No opiate had been administered. His abdominal cavity contained the usual amount of duodenal contents and the peritoneum was markedly injected. More than half the cases show obliteration of liver dullness either partial or complete. It is merely a corroborative sign and is in no wise pathognomonic. The left shoulder pain mentioned as occassionally occuring early after perforation is probably a pneumogastric-spinal accessory reflex rather than of peritoneal or anginal origin. In the preperforative irritation stage physical examination may reveal acute tenderness over the ulcer with some rigidity of the overlying muscles. This connotes a deep ulcer with peritoneal irritation and should be an indication for surgical intervention. (Case 7 well illustrates this danger signal: the patient, a female of 57 years, for 6 months had typical hunger pains occuring 3 hours after eating. Her examination elicited acute tenderness over the site of the pylorus and moderate rigidity of the rectus. Temperature, pulse, and blood count were normal. She was put to bed and placed upon Lenhartz diet. Tenderness and muscle spasm persisted. On the eleventh day of treatment, perforation occured suddenly while she was at absolute rest.)

Treatment of acute perforations. The treatment is immediate operation regardless of any degree of shock that may be present as the patient's condition rapidly improves with the relief of intraperitoneal tension. The abdomen is dry shaved, painted with iodine, and washed off with alcohol. Under ether anæsthesia a 4 inch mid-right rectus incision is deepened down to the peritoneum. A point of practical importance is to determine the lower border of the liver. This should limit the upper angle of the incision. If a small nick be first made into the peritoneum a little free fluid will well up into the incision, and gas bubbles erupting through this clinches the diagnosis of perforation. The escaped contents is best aspirated, especial attention being paid to Morrison's space, the right lumbar gutter, and to the toilet of the pelvis. With moist pads the surrounding structures are gently pushed aside and the perforation sought. Fibrin deposits are an excellent guide to the point of perforation and not infrequently gas bubbles point out the way. If the perforation is obscure, slight pressure on the stomach may cause bubbles to appear. Closure of the perforation is accomplished by

SUMMARY OF FIFTEEN CONSECUTIVE CASES OF ULCER OF DUODENUM

No.	Age Sex Nationality Occupation	Previous History	Present History	T. P. R. W. B. C.	Examination	Preoperative Diagnosis	Findings	Procedure	Results	Remarks
30652 M. S. 1.	42 M. Russia Painter	Indefinite history of occasional discomfort after meals past 4 5 yrs.	*Sudden* severe pain in right upper quadrant soon general. *No vomiting.*	T. 100 P. 80 R. 28 W. B. C. 16000 Polys. 85%	*Comfortable.* Slight distention. Thoracic respiration. Mod. tenderness R. side, Mod. rigidity L. side, *not board like.* P. costal rigidity. *Obliteration liver dullness* below 6th space. No tenderness P. R.	Perforated duodenal ulcer	Ulcer 1 cm in diameter on anterosuperior surface of duodenum. Just beyond pyloric vein. 3 mm. perforation, much fluid, peritoneum not injected. Pylorus patent.	Closure with purse-string of chromic reinforced with linen covered with tab of omentum. No drainage. Time 35 min. (Free fluid aspirated)	Cured	Indefinite history. No board-like rigidity. No vomiting. Culture sterile. Operation 12 hrs. after perforation. (Obliteration of liver dullness.)
0297 A. T Pv. C. 2.	53 M. Austria Designer	Typical hunger pains past 4 yrs., with periodicity.	*Sudden* sharp epigastric pain, soon becoming general. *No vomiting.*	T. 100 P. 76 R. 28 W. B. C. 20000 Polys. 93%	*Moderate shock.* No distention. Resp. thoracic. Moderate tenderness entire; board-like rigidity upper abdomen, moderate R.L.Q None L.L.Q. Tenderness P. R. Obliteration liver dullness in lower 3 spaces	Perforated duodenal ulcer	Free gas; bile-tinged gastric contents; 1 cm. ulcer on anterior surface of duodenum just beyond pyloric vein 2 mm. perforation. Pylorus patent. Peritoneum moderately injected.	Same as above. Time: 33 min. (Free fluid aspirated with Poole sucker)	Cured	Typical history. No board-like rigidity No vomiting. High blood count. Culture sterile. Operation 8.5 hrs. after perforation. (Obliteration of liver dullness)
26707 G. C. 3	50 M. U. S. Janitor	Lues. Alcoholism. Recurring periodic attacks of hunger pain past year. No melena.	*Sudden* severe epigastric pain with feeling of sizzling. Soon general. Since admission almost, pain. Nausea. Vomiting.	T. 99 P. 80 R. 24 W. B. C. 12000 Polys. 85%	Comfortable, *sitting up,* wanted to go home. Mod. rate tenderness and moderate rigidity in R.U.Q., less in R.L.Q. and L.U.Q. No tenderness P. R. *Obliteration liver dullness* below 6th space	Perforated duodenal ulcer	Free gas; bile-tinged fluid. Plastic peritonitis about duodenum, peritoneum injected. 1 cm. ulcer on anterior surface of first part duodenum, 3 mm. perforation. Pylorus patent.	Transverse incision. 2 drains: kidney pouch and pelvis. Time: 40 min. (Free fluid aspirated with Poole sucker)	Cured Hernia in wound; repaired.	Very comfortable, wanted to go home. Culture not reported. Operation 18 hrs. after perforation. (Obliteration of liver dullness)
28256 T. F. 4.	43 M. England Laborer	Past 5 months frequent pains about 2 hrs. P. C.	*Sudden* severe epigastric pain, soon general. Began when asleep. *No vomiting*	T. 100 P. 120 R. 32 W. B. C. 12000 Polys. 85%	*Board like* rigidity in R.U.Q., less R.L.Q. and L.U.Q. Tenderness moderate. Thoracic respiration. R. costal rigidity. *Obliteration liver dullness* below 7th space.	Perforated pyloric ulcer	Free gas; much fluid. Ulcer 2 cm. on anterior surface first part duodenum. 2 mm. perforation in its crater. Peritoneum not injected. Pylorus patent.	Perforation closed with chromic, reinforced with linen. (Free fluid aspirated) Time: 30 min.	Cured	Typical history. Board-like rigidity. Culture sterile. Operation 5.5 hrs. after perforation. (Obliteration of liver dullness)
27542 F. F. 5.	34 M. U. S. Mechanic	Lues and moderate alcoholism. 10 yrs. ago attack called appendicitis. None since.	*Sudden* cramp-like pain in epigastrium, soon general. Vomited once.	T. 101 P. 96 R. 28 W. B. C. 8000 Polys. 75%	*Board-like rigidity* over all, most marked R. rectus. Very tender over all. Very tender P. R. Liver dullness not noted	Perforated duodenal ulcer	Free gas, much fluid. Marked injection peritoneum. Ulcer 3 cm. at pylorus and duodenum with perforation 2 mm. to right of pyloric vein. Pylorus admitted tip of little finger.	Closure of perforation with tab of omentum. Free fluid aspirated. Drains: Kidney pouch and pelvis.	Cured	Typical history. Board-like rigidity. Liver dullness not noted. Operation 10 hrs. after perforation.
26690 L. G. 6.	33 M. Italy Shoemaker	Similar attack 2 yrs. ago? None since.	24 hrs. ago moderate epigastric pain soon localized in R.L.Q. About all day. Vomited twice.	T. 101 P. 98 R. 24 W. B. C. 11000 Polys. 86%	Slight distention. General abdominal tenderness most marked in R.L.Q. General rigidity most marked in R.L.Q. No costal rigidity. No obliteration liver dullness. No mass P. R.	Perforated Appendicitis with diffuse peritonitis	Free fluid. Peritoneum injected. 2 cm. ulcer on anterior surface first part duodenum, 4 mm. perforation.	McBurney incision. Appendectomy. Usual closure ulcer. Drains: Kidney pouch and R. lumbar gutter.	Cured	Typical appendix history. No free gas. No obliteration liver dullness. Operation 26 hrs. after perforation.
J. P. 7.	57 F. U. S. None	Past 6 mos. periodic attacks of pains. 3 hrs. P. C.	In bed 11 days. On Lenhartz diet. Sudden epigastric pain, soon general. No vomiting.	T. 97 P. 120 R. 30 No cell count.	Shock. Extreme distention simulating obstruction. Marked general tenderness and peritoneal reflex.	Perforated duodenal ulcer	Great amount free gas. 3 mm. perforation in ulcer 1 cm. in diameter anterior surface first part duodenum. Peritoneum slightly injected	Closure ulcer with chromic catgut and linen, reinforced with tab of omentum. Fluid aspirated.	Cured	Marked distention simulating obstruction. Diagnosis rested on history. Operation 3 hrs. after perforation.

28728 T. M. 8.	43 M. U. S. Metal worker	Negative.	2 weeks: Gradual onset pain in R. hypochondrium and lumbar region. Vomited. Working	T. 100 P. 100 R. 28 W. B. C. 18000 Polys. 88%	Ovoid swelling from right costal margin to iliac crest. No rigidity. Rest of abdomen negative.	Appendiceal abscess	Mass from under surface liver to pelvic brim, extracolic. Pylorus and duodenum adherent to under surface liver; indurated.	Drainage of abscess.	Cured	X-ray reveals peripyloric and duodenal adhesions. Refused further operation. Operation 2 weeks after perforation.
33772 R. B. 9.	23 M. U. S. Guard	4 yrs. periodic attacks of pain. 1 to 3 hrs. P. C.	*Sudden* pain in R. L. Q. Vomited. Pain soon general.	T. 99 P. 80 R. 24 W. B. C. 13000 Polys. 84%	No shock. In pain. Thoracic respiration. Costal rigidity. General abdominal tenderness and rigidity. Obliteration liver dullness below 6th space.	Perforated duodenal ulcer	Free gas. Much fluid. 1 cm. ulcer with 1 mm. perforation 2 cm. beyond pyloric vein.	Usual closure.	Cured	Appendiceal type. Operation 4 hrs. after perforation.
29642 M. H. 10.	39 M. Russia Baker	10 yrs. periodic pains. 2 to 3 hrs. P. C. Treated for gastric ulcer. Lost 30 lbs.	Sudden severe epigastric pain, soon general *Vomiting.*	T. 100 5 P. 80 R. 32 W. B. C. 26000 Polys 84%	No distention or shock. General abdominal tenderness. General abdominal rigidity. Most marked R U Q. Tender P R. Obliteration liver dullness.	Perforated duodenal ulcer	Peritoneum injected. 3 cm indurated ulcer involving both pylorus and duodenum. 1 mm. perforation. Pylorus admitted only tip of little finger.	Closure of perforation with omentum only. Ulcer too friable. Gastrojejunostomy 4 weeks postoperative.	Cured	Perforation 9 hrs. before operation; patient poor condition; peritoneum injected.
34618 L. S. 11.	26 F. Austria H. W.	Very indefinite in digestion 4 yrs	Sudden epigastric pain 1 wk. ago Pain easier until yesterday Sudden severe pain all over abdomen Vomited	T. 100 P. 130 R. 28 W. B. C. not taken	Hippocrates facies General abdominal tenderness General abdominal rigidity. Mostly right sided. Tender both fornices No masses	Pelvic infection with general peritonitis.	No free gas. Creamy pus general. Appendix and tubes normal 1 cm ulcer 1st part duodenum with many adhesions and thick fibrin. Minute perforation.	Usual closure. No drainage except intramural.	Cured	Stormy convalescence at first Very slow perforation. Walled off for 6 days, then becoming general.
43812 J. G. 12.	42 M. Russia Painter	Past 20 yrs indef. hist Gastric distention occurring ½ to 2 hrs after meals Occasional vomiting. No blood	*Sudden* severe pain, epigastrium Nauseated, no vomiting	T. 99 P. 90 R. 26 W. B. C. 12800 Polys. 92%	In slight shock. Acute pain Abdomen retracted. Board like rigidity R costal vertebral rigidity. Tender P R. Liver dullness partial obliteration	Perforated duodenal ulcer	Ulcer 1 cm in diameter on antrior surface of duodenum just beyond pyloric vein. Perforation 4 mm in diameter. Pylorus patent.	Closure with chromic catgut reinforced with omental tab.	Died 3rd day—pulmonary embolism	Indefinite history. Case referred to hospital as lead colic. No vomiting; culture sterile. Operation 3½ hrs. after perforation.
4318 E. M. 13.	21 M. U. S. Student	For 6 months distress when stomach empty. Heartburn.	Sudden severe epigastric pain Soon general, no vomiting. Immediate prostration.	T. 99 6 P. 90 R. 30 W. B. C. 22000 Polys. 92%	No shock; general abdominal rigidity, boardlike in U. Q. Distinct R costal vertebral rigidity. Liver dullness obliterated, 5 cm above costal margin Acute tenderness P. R.	Perforated duodenal ulcer	Much free gas. 1 cm. ulcer just beyond pyloric ring; 4 mm. perforation.	Pylorus patent. Inversion of ulcer, reinforced with omental tab. Time 30 min. No drainage.	Cured	Suggestive history. No vomiting. Culture sterile. Operation 6 hrs. after onset. Secondary gastro-enterostomy.
47564 A. S. 14.	31 M. Russia Collector	5 yrs. indefinite indigestion. 1 yr pains 1 hr. P. C.	Sudden onset. Severe epigastric pain. Soon general Vomited twice; chill	T. 100 P. 94 R. 28 W. B. C. 16000 Polys. 89%	Patient acute pain; no shock; thighs flexed. Respiration thoracic Board like rigidity, upper abdomen; slight, lower.	Perforated duodenal ulcer	Just beyond sphincter 3 mm. perforation in ulcer. Calloused; 3 cm. diameter. Stenosis following inversion.	Closure; reinforced with omental tab. Primary gastro-enterostomy Time. 48 min.	Cured	Typical history. Vomiting. Operation 10 hrs after perforation
47360 G. L. 15.	40 M. U. S. Policeman	Definite history past 3 yrs. Pain 2 to 3 hrs. after meals Treated for ulcer.	Sudden onset, after meals Slight collapse No vomiting.	T. 98 6 P. 82 R. 22 W. B. C. 15000 Polys. 72%	Slight shock, board like rigidity over all R costal vertebral rigidity. Obliteration liver dullness. Tender P. R	Perforated duodenal ulcer	1 cm perforation in ulcer, 2 cm. hard, calloused. Adhesions.	Closure with omental tab. Primary gastro-enterostomy. Time. 52 minutes.	Cured	Definite history. Board like rigidity. No vomiting. Sterile culture. Operation, 7 hrs. after perforation.

T., Temperature.
P., Pulse.
R., Respiration

W. B. C., White blood cells.
Polys., Polymorphonuclears.
R. U. Q., Right upper quadrant.

L. U. Q., Left upper quadrant.
L. L. Q., Left lower quadrant.
L. U. Q., Left upper quadrant.

R., Right.
L., Left.

P. R., Rectal.
P. C., After meals.

infolding the ulcer with fine chromic catgut reinforced occasionally with an omental tab. The expediency of a primary, gastro-jejunostomy is determined by the pathology. If simple closure is performed, one tests the patency of the lumen of the gut. If the tip of the little finger can be insinuated through the site of closure, there is little danger of obstruction. One then makes a search for secondary ulcers, gall bladder and appendiceal disease.

The added risk of primary gastro-emterostomy before the advent of peritonitis is slight in a patient whose condition during operation is good, as regards respiration, aeration, and circulation. The danger of working in a potentially infectious field is more theoretical than real. The real dangers are two-fold: (1) a 2 to 3 per cent chance of future gastrojejunal ulcer formation and, (2) the late secondary sequelæ which occur in several cases despite perfect technique in the hands of the most skillful. Therefore, unless the pathology is such as to demand a primary gastro-enterostomy, simple closure should be performed. A good practical rule is, when in doubt, don't do a gastro-enterostomy. It can be performed later, if indicated.

If a careful peritoneal toilet be made by aspiration there is no need of drainage except to the mural tissues. The suprapubic stab wound seldom drains, but may produce adhesions and is contra-indicated. Drainage to the site of closure is never instituted as several duodenal fistulæ have resulted thereby. The slow perforations with abscess formation are best treated by simple incision and drainage. If a fistula ensues, a secondary closure with gastro-enterostomy is indicated.

Following operation the patient is placed in a semi-recumbent position, given one or two doses of morphine and a 5 per cent glucose and 5 per cent sodium bicarbonate rectal drip. Small amounts of water by mouth are permitted after 4 hours. On the third day, Lenhartz's treatment is instituted and adhered to for its entire course. At this time, the foot of the bed is kept elevated about 6 inches. Frequently small amounts of alkalies are administered the first 2 weeks. The patient is then given a light, selected, non-bulky diet with crackers and milk between meals for the next 2 weeks. At the end of the month a roentgenologic examination is made. The patient upon discharge is warned of the dangers of dietary indiscretions and asked to report if any symptoms return. Nine of 12 cases radiographed failed to show any 6 hour residue. The motility in most was practically normal. Of the three cases having retention after 6 hours, two had it to a marked degree. All three of these at the time of operation presented calloused ulcers. Two would have had primary gastro-enterostomies performed had their conditions permitted. The third was omitted through ignorance of the pathological indication.

Of the 15 cases comprising this study, 13 were males, 2 females. The ages varied from 21 to 57, averaging 37 years. Eight patients, 53 per cent gave a previous typical ulcer history of varying duration from a few months to 10 years. Five, 33 per cent, had an indefinite history of dyspepsia. In 2, there were no previous symptoms up to the moment of perforation, 13 per cent. (In these the evidences of inflammation and repair were absent and the picture was one of focal necrosis.) In no case was there a history of hæmatemesis or melæna. Only three (20 per cent) perforated within the first year of symptoms. The average duration of symptoms until perforation was 3½ years. Of the 15 perforations, 13 were acute and 2 slow perforations. Of the slow perforations one presented a large abscess extending from the liver to the iliac crest. This was of 2 weeks' duration. The other case slowly perforated and apparently remained localized for 1 week and then ruptured, producing a diffuse peritonitis. Of the acute ruptures (13), the shortest time elapsed after perforation until operation was 3 hours, the longest 26 hours, the average time being 10.6 hours. The average temperature was 100° per rectum, pulse 90, respiration 24, white blood cells 15,100 with 85 per cent polymorphonuclears. Cultures were taken in 11 cases and were reported sterile. Of the 13 acute perforations, a correct preoperative diagnosis was made in 12.

Of the 13 acute perforations the soft type ulcer presented in 8 cases (61.5 per cent) and

the calloused ulcer in 5, (39.5 per cent). Two of these soft ulcers were of the acute necrotic type and had no digestive disturbances prior to admission. In all 8 cases simple closure was performed. Primary gastro-enterostomy was performed twice for calloused ulcer, and secondarily, within 1 month of the simple closure in 2 others. The fifth case felt so well, it seemed unnecessary. He remained well over 2 years and has recently had a gastro-enterostomy performed because of severe hæmorrhage, apparently from the old ulcer site. This pathology was not sufficiently appreciated at first operation.

The immediate results were excellent in all 15 cases, save one patient, simple closure, who died suddenly on the fifth day from pulmonary embolism, giving a mortality of 6.6 per cent. One patient in whom a transverse incision was made, returned in 3 months suffering from a ventral hernia. During repair, the duodenum was carefully searched for the old ulcer site—it had been a soft ulcer type with a history of symptoms for 1 year prior to perforation. The duodenum appeared absolutely normal. One other developed an acute suppurative cholecystitis 2 years after discharge and required cholecystectomy. The duodenum showed no evidence of adhesions or previous disease, and the ulcer site had entirely disappeared. This also was a soft ulcer type with digestive disturbances of 2½ years prior to perforation. At the time of his first operation the gall bladder had appeared normal. Thus two of eight soft ulcer types, 20 per cent, treated by simple closure resulted in a complete restitution of the duodenum. This evidence though small, is very suggestive. In addition, the remaining 5 cases (one died) of soft ulcer perforations had remained well over a long period of time.

The average time elapsed since operation is 3 years and 1 month, the longest period 10 years, the shortest 2½ months. Excepting two cases operated upon, 3 and 2½ months ago respectively, and whose present conditions are satisfactory but too early from which to draw conclusions, the next most recent case is of 18 months' duration. The present condition, as reported within the last 4 months, of 10 cases of acute perforation, 7 of whom presented soft type ulcers and 3 calloused ones and in whom the average time elapsed since operation has been 3 years and 6 months, is as follows: Of the soft type 7, in whom simple closure was performed, all are well and symptomless. One of the calloused types has recently had a gastro-enterostomy performed for hæmorrhages. Of the two others in whom secondary gastro-enterostomies were performed before leaving the hospital, one was well 14 months after operation, and the other complains of dragging pains in the region of the wound, and periodic attacks of diarrhœa. All but two have gained weight, the average being 6¼ pounds.

In conclusion, one seems justified in emphasizing the importance of reporting the end-results of the treatment of perforated ulcers of the stomach and duodenum as separate entities. The immediate results depend more upon the time interval that has elapsed after perforation than upon surgical therapy. It is well recognized that most cases operated upon within 12 hours of perforation terminate in recovery. Only by careful follow-up records extending over many months can reliable statistics be obtained as to ultimate cures. Moreover, a fuller appreciation of the pathological problem presenting in each case should result in a more rational method of treatment. To state dogmatically that all cases treated by simple closure will result in permanent cure is as illogical, as to insist upon a primary gastro-enterostomy as a universal procedure.

THE ANOMALOUS RIGHT SUBCLAVIAN ARTERY AND ITS POSSIBLE CLINICAL SIGNIFICANCE

By A. A. GOLDBLOOM, Philadelphia
From the Laboratories of the Daniel Baugh Institute of Anatomy of the Jefferson Medical College, Philadelphia

NORMALLY, there are three main branches from the proper arch of the aorta. From right to left they are the innominate which divides into the right subclavian and the right common carotid; the left common carotid; and the left subclavian arteries, respectively.

The origin of the right subclavian is opposite the right sternoclavicular articulation, and from that point the artery ascends upward and outward in a gentle curve over the dome of the pleura to the inner border of the anterior scalene muscle.

The origin of the left subclavian is from the termination of the transverse portion of the aortic arch and consequently is much deeper in the thorax. From its origin it ascends at first almost vertically and then curves outward and slightly forward to reach to the inner border of the anterior scalene muscle. From this point onward the course of the two arteries is the same.

An anomalous origin from the arch of the aorta of the right subclavian artery distal to the point of origin of the left subclavian and coursing between the œsophagus and the vertebral column, on the level of the second to fourth thoracic vertebræ, is not unknown. In a dissection of 225 bodies at the Jefferson Medical College four such arteries were encountered. Owing to the similarity in the anatomy of the four specimens a description of one of them will suffice.

DESCRIPTION OF THE ANOMALOUS SPECIMEN

The right subclavian artery comes off as a branch of the aortic arch, at the junction of the transverse and descending portions of the aorta. It arises on the left side of the body, 1.5 centimeters distal and to the left of the left subclavian artery as an independent branch, instead of its normal origin from the innominate artery on the right side of the body (Figs. 1 and 3). The anomalous vessel maintains a curve and comes off at an angle of 120 degrees from the descending aortic limb. It ascends forward, upward, and outward, being in relation with the trachea and œsophagus ventrad, and with the vertebral column dorsad, on a level with the third and fourth thoracic vertebræ (Figs. 1 and 3). Here it is at an angle of 45 degrees with the left subclavian artery. When it reaches the middle of the second thoracic vertebra, the vessel leaves the vertebral column to reach the root of the neck on the right side, where it bends at an angle of 40 degrees. It reaches 3 centimeters above the level of the right first rib; and here maintains its position and gives off branches as normally. The length of the anomalous artery from its origin to where the vertebral artery comes off is 8.75 centimeters; the diameter at its origin is 2 centimeters; where it crosses the vertebral column approximately 1.25 centimeters; and where the vertebral arises, 1 centimeter.

Associated with the anatomic variation the two common carotids arise as the first and second branches of the aorta; the left subclavian as the third; and the right subclavian as the fourth main branch (Figs. 1 and 3). The innominate artery is, of course, absent. There are slight variations in the exact place of origin of the right subclavian artery in these conditions: Sometimes it proceeds from the upper part of the arch; again from the posterior aspect; but most commonly from the junction of the transverse and descending parts of the arch,—the point of origin in these specimens.

The right common carotid artery arises from the commencement of the transverse portion of the aortic arch, usually the point of origin occupied by the innominate artery, and is 10.25 centimeters from the beginning of the aortic arch (Figs. 1 and 3). The left common carotid artery arises 1.5 centimeters from the right common carotid, making the point of origin 11.75 centimeters from the beginning of the aortic arch. In this respect it

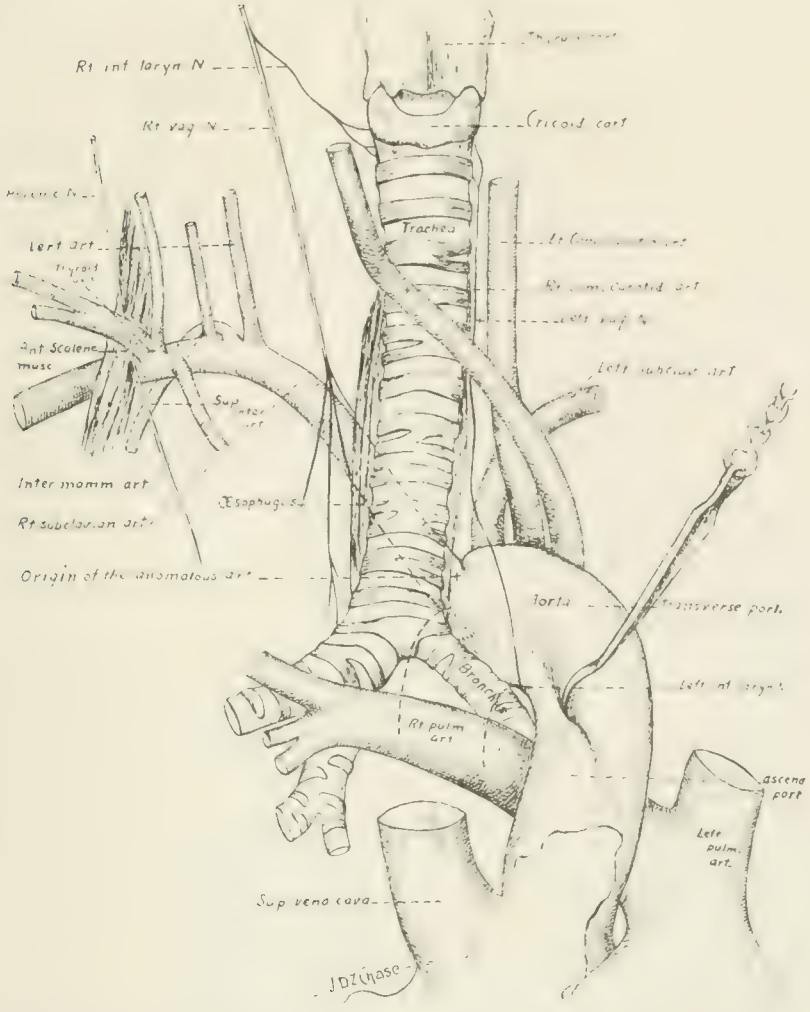

Fig. 1. A dissection showing the course and origin of the anomalous right subclavian artery. The arch of the aorta is pulled, or rather rolled, toward the left so as to expose the origin of the anomalous right subclavian from the descending portion of the thoracic aorta.

occupies a position more to the right than is normal, and it covers a greater surface of the trachea where it crosses to its distribution on the left side of the neck. Both carotids are in relation to the trachea laterally, but the left is more intimately related and crosses the trachea at an angle whereas the right ascends upward with no angulation.

The left subclavian artery arises 4.5 centimeters from the right common carotid in the mid-portion of the transverse arch,—the normal point of origin of the left common carotid artery, thus varying in its normal point of origin at the termination of the transverse portion of the aortic arch.

The first branch of the anomalous right subclavian artery is the vertebral (Figs. 1 and 3) coming off at a distance of 8.75 centimeters from the point of origin of the anomalous artery, and corresponding to the position of a normal vertebral artery. This is worthy of note on account of the variations in the point of origin of the right vertebral in cases of anomalous right subclavian arteries such

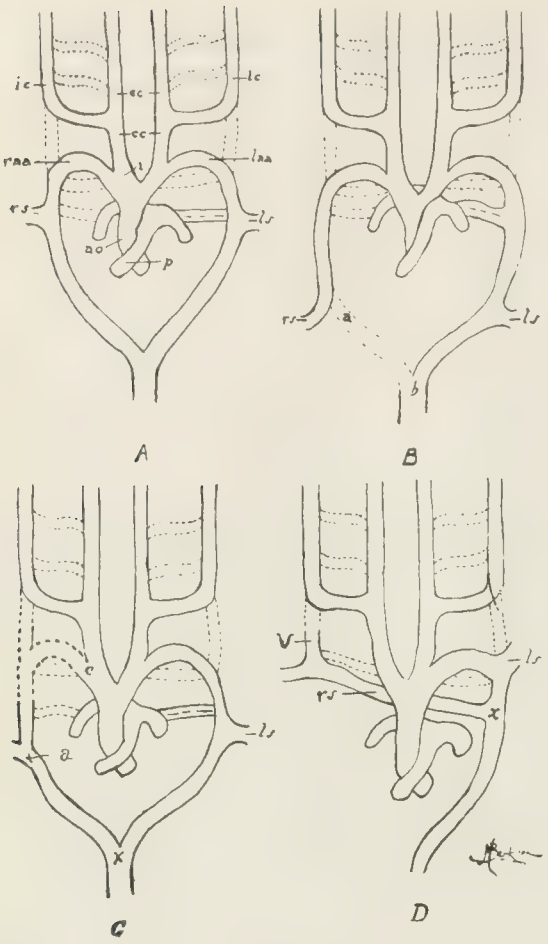

Fig. 2. Series of schemata of the embryonic arterial arches in explanation of the anomalous right subclavian artery described in the text. The dotted lines indicate points of absorption. *A*, Primitive condition; *B*, customary development; *C*, unusual development and early stage of the anomalous right subclavian artery; *D*, a later stage of the anomalous right subclavian following developmental adjustments of parts (see text). *ic*, Internal carotid artery; *ec*, external carotid artery; *cc*, common carotid artery; *raa*, right aortic arch; *laa*, left aortic arch; *i*, innominate artery; *ao*, aorta; *p*, pulmonary artery; *rs*, right subclavian artery; *ls*, left subclavian artery; *v*, vertebral artery; *x*, point of origin of anomalous right subclavian artery.

as described here. The vertebral artery directly ascends, with no tortuosity, for a distance of 4.5 centimeters and then enters the foramen in the transverse process of the sixth cervical vertebra. The other branches of this segment of the anomalous right subclavian artery are present as normally, as are those of the second and third parts. (The specimen described by J. E. Mears was unusual in that the thyroid axis was absent in both subclavian arteries.) The right subclavian artery is crossed ventrally in the root of the neck by the right pneumogastric (vagus) nerve, but the inferior (recurrent) laryngeal nerve does not form a loop around the subclavian artery as normally, but passes directly to its usual distribution. It is not recurrent in character as is customary for it (Figs. 1 and 3).

EMBRYOLOGY

In these conditions there is a defect in the absorption of the primitive right aortic arch in the embryo (Fig. 2 C). Absorption occurs ordinarily distal to the point of origin of the right subclavian artery (Fig. 2 *B*, *a-b*). In this condition absorption is along the fourth arterial arch (Fig. 2 *C*, *a-c*). The embryonic right aorta becomes the right subclavian artery (Fig. 2 *C*, *a-x*). In a transformation of the aortic arches into the arteries of the neck normally the fourth aortic arch on the right side persists with the descending aorta as far as the seventh intersegmental artery to become the right subclavian artery (Figs. 2 *A* and 2 *B*). The explanation of this anomalous right subclavian seems to be that in some way in very early embryonic life the right fourth arterial arch which normally becomes the innominate (Fig. 2 *A*, *i*) fails to develop (Figs. 2 *C* and 2 *D*).

The right arch beyond the origin of the right common carotid artery, or that part which normally continues into the right subclavian (Fig. 2 *C*, *a—c*) in part atrophies and disappears; while the lower part of the right aortic root (Fig. 2 *B*, *a-b*) remains patent and continues to grow in connection with the back part of the aorta. This, being in connection with the origin of the right subclavian artery carries the blood into that vessel which is detached from its natural supplying channel. To reach this vessel the blood passes along that portion of the right aortic root which intervenes between the origin of the right subclavian and the place where the two aortic roots join to form the secondary trunk of the aorta (Fig. 2 *C*, *x*). This root

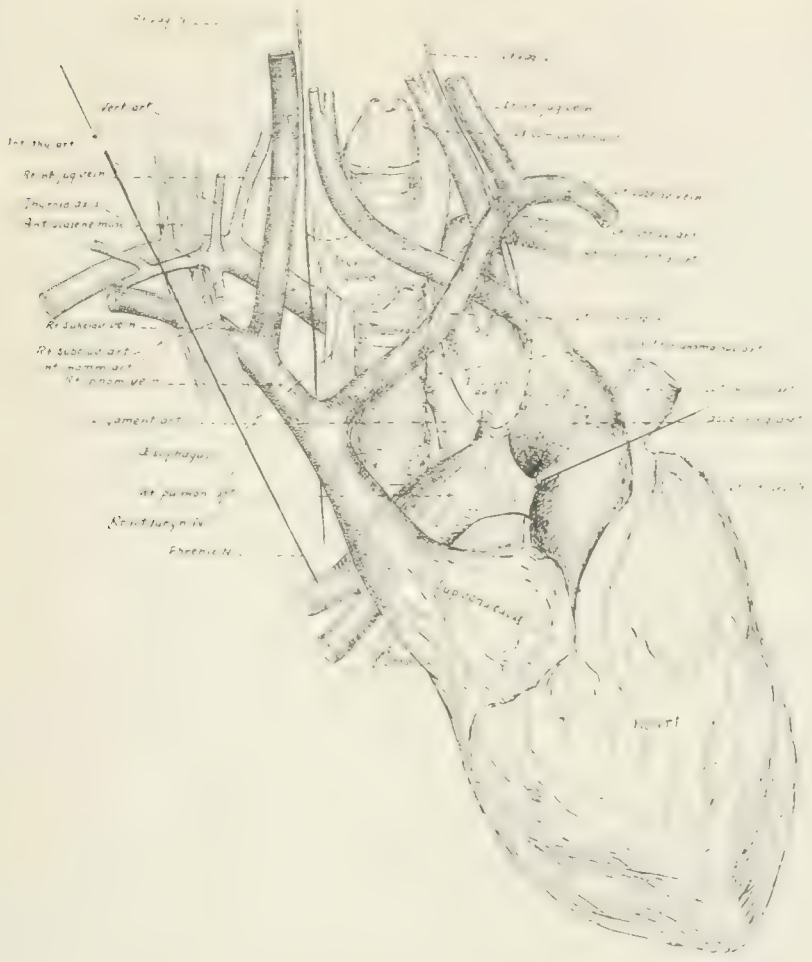

Fig. 3. Dissection showing an anomalous right subclavian artery arising distal to the normal left subclavian and coursing to the right arm behind the trachea and the œsophagus.

remains pervious and persistent (Fig. 2 *C*, *a-x*), instead of disappearing as is usually the case (Fig. 2 *B*, *a-b*).

The position of the right subclavian artery dorsal to the trachea and œsophagus may be explained as follows: As the right aortic root lies dorsad to the trachea and œsophagus and pursues the direction which is followed by the commencement of the right subclavian in cases as described above (Fig. 2 *C*, *a-x*), we must regard the first part of the artery in it; that is, the part dorsad to the trachea and œsophagus as really formed of the persistent pervious right aortic root.

Through the heart-shaped space (Figs. 2 *C* and 2 *D*) the pulmonary system and the heart descend ventrally so that the trachea comes to lie ventral to the anomalous right subclavian artery when this forms. The œsophagus occupies the same position since the large blood vessels develop around the foregut. The latter lies from the first in the loop ventral to the dorsal aorta and will, therefore, be ventral to an anomalous right subclavian artery since the artery represents in part the original right dorsal aortic arch.

There are two explanations for the cephalic position of the right subclavian artery on

the left arch (arch proper) of the aorta (Fig. 2 *D*, *rs-x*): One is that there is a migration of the vessel from point *a-x* in Fig. 2 *C* to point *rs-x* in Fig. 2 *D*. On the other hand there may be an apparent migration and the real change is a dragging down of the aortic arch by a downward movement of the heart and pulmonary system. The second view appears to be a better explanation for the dorsal position of the right subclavian artery. Probably both processes progress *para passu* bringing about adult conditions as found in these observations.

As stated above the vertebral artery in its origin is normal. This is an interesting fact since its point of origin is the extent and position of the absorption of the right, fourth primitive arch. An obstruction arising at an early period in the right fourth arch internal to the origin of the vertebral artery (Fig. 2 *D*, *v*), would necessitate the persistence of the connection of the outer end of the arch with the aorta to carry blood to the right arm and right vertebral artery. This would give rise to an abnormal right subclavian with a vertebral artery as one of its branches (Fig. 2 *D*, *v*). Under such circumstances the absorption of the right arch would be complete medially. If the obstruction had occurred immediately beyond the origin of the vertebral (Fig. 2 *C*), the internal half of the fourth arch would remain in continuity with the vertebral, supplying blood to it and thus would give rise to the origin of the vertebral from the aorta or even from the right common carotid artery. Under such circumstances there would not be a complete absorption medially of the right arch.

Position of the right inferior laryngeal nerve. In all of these instances of anomalous origin of the right subclavian artery, the right inferior laryngeal nerve does not wind around the artery in proceeding to its distribution (Figs. 1 and 3). The left pneumogastric and inferior laryngeal nerves possess their normal course. The so-called "recurrent" nerve arises from the trunk of the pneumogastric far cephalically before that nerve crosses in front of the right subclavian, but instead of turning around behind that vessel, it passes slantingly upward to the larynx. This altered position of the inferior laryngeal nerve tends to confirm the view of the complete atrophy of the fourth and fifth right vascular arches. This, of necessity, precludes this nerve from possessing its normal "recurrent" direction.

It is further to be noted that the pneumogastric nerve as it passes from above downward, from without the vascular arches, to join the root of the lungs and the œsophagus on each side, gives off its recurrent or inferior laryngeal branch below the last arch. As the latter nerve proceeds upward to the larynx within the vascular arches, it follows that when the neck comes to be elongated by the extension of the parts between the third and fourth vascular arch arteries, the pneumogastric nerves are drawn down with the lowest persistent arch around which the recurrent nerve originally curved. If then any of the lower arches should permanently disappear, we may expect to find the bend of the recurrent nerve not passing lower than the place where it is held down by the next persistent arch.

Further explanation for the failure of the inferior laryngeal nerve to wind around the subclavian artery in these cases may be referred to the earlier periods of the existence of the fœtus when the larynx is placed behind the ascending portion of the arch of the aorta, while the head rests on the thorax and in front of the ascending portion of the aortic arch. The inferior laryngeal nerve passes dorsad to the larynx, the left going to the arch of the aorta and the right below the innominate artery. As gestation advances the neck lengthens and the brain is removed upward in accommodation to which the nerves become elongated, suspending the arch of the aorta and the right subclavian artery in loops. When the right subclavian arises on the left side it passes dorsad to the larynx and is, therefore, not embraced by the inferior laryngeal nerve.

FREQUENCY OF OCCURRENCE

Quain found this anomaly present four times in one thousand cases, Holzapfel six times in one thousand, and Tiedeman eight times in one thousand. Holzapfel collected

two hundred cases of abnormal right subclavian arteries including four of his own, and gives the frequency as one case in one hundred sixty-seven cadavers, or 0.6 per cent. Cobey gives the result of an investigation made by Arthur Thomson for the Anatomical Society of Great Britain and Ireland as five in five hundred, or 1 per cent. The cases reported from the University of California Medical School (Harvey) are two in two hundred thirty-seven cadavers, or 0.8 per cent. Bean reported two cases of his own and six others in the literature, besides Holzapfel's cases. Cobey and Bevier each reported one case. The writer in an investigation made in the dissecting laboratories of the Jefferson Medical College found four in two hundred twenty five cadavers or 1.6 per cent. Holzapfel gives the following among many conclusions: "The anomaly passes between the œsophagus and vertebral column (107 times), seldom between the œsophagus and trachea (25 times), and rarely in front of the trachea (6 times). The anomaly was found sixteen times in persons beyond the age of 50 years and occurs in normal and abnormal individuals, anatomically."

PRACTICAL APPLICATIONS

Dysphagia. Some internists think that where such an arterial abnormality exists, the close relation of the subclavian to the œsophagus occasions a difficulty in swallowing. Bayford was the first to direct attention to this particular form of dysphagia, describing it under the name "dysphagia lusoria." Doctor Bayford's patient in whom the right subclavian coursed between the trachea and the œsophagus had difficulty in deglutition. The anomalous subclavian artery between the œsophagus and the vertebral column would in all probability cause similar dysphagia.

Quain quotes the history of a patient having difficulty in deglutition as follows: "In an examination of the body of a female who died at an advanced age, the right subclavian artery was found to arise from the left side of the arch of the aorta and to cross behind the œsophagus to its usual position on the first rib. It was ascertained that the person had been, for some time before death, subject to pain in the stomach and difficult deglutition; and those symptoms were augmented toward the close of life to such an extent that she refused to take any food, except fluids, declaring her inability to swallow." Quain quotes Professor Otto as observing a person in whom such a condition existed and there was not the slightest difficulty in swallowing.

Three cases of "dysphagia lusoria" have been reported in connection with this anomaly. One by Bayford in which a patient 61 years of age who had been suffering from difficult deglutition throughout life, died from inability to swallow; another, by Autenreith and Pfleiderer, in which a woman about 60 years of age died of slow starvation; and a third, by Brewer of simple dysphagia. In all these cases there was an associated aneurism of the anomalous right subclavian artery at its origin. Of great interest in connection with the matter of slow starvation is the juxtaposition of the dilated anomalous vessel to the thoracic duct, which may be subjected to pressure as it lies upon the vertebral column.

A case of erosion of the vertebræ by the right subclavian was reported by Picard in which the artery passed between the œsophagus and the vertebral column. A case of sudden death from swallowing a large mouthful, resulting in rupture of an anomalous right subclavian artery, was reported by Kirby.

Lefthandedness. An ingenious theory has been propounded by Doctor Oehl and Professor Hyrtl of Vienna correlating the disposition of the vessel with lefthandedness. Turner also offers a questionable explanation of the coexistence of these two conditions. Holzapfel believes that these anomalous right subclavian arteries are not the anatomical cause of lefthandedness. The theory appears fanciful despite the fact that the two conditions exist in a number of cases.

Surgical application. Surgically the abnormal course of the right subclavian artery is important. Attention should be directed to the first part of the artery proximal to the anterior scalene muscle. Sometimes ligation of this part is necessary, and one must re-

member that the artery lies dorsad to the right-common carotid artery and deep, separated by a considerable amount of connective tissue. In one instance reported, the position of the vessel offered a decided difficulty in securing it. That of Mr. Liston is another who had the first part of the anomalous subclavian artery the seat of an aneurism and he experienced great difficulty in finding the vessel at operation. The direct course from the vagus nerve to the larynx of the inferior (recurrent) nerve should be a point of practical interest in operations on the front of the neck. Unequal radial pulses have also been noted in these cases. It may be suggested that the pressure on the vessel may lead to trophic changes in the subclavian artery. Its vascular nerves come directly from the ganglionated sympathetic cord. The arteries beyond the axilla would in all likelihood escape trophic disorder since they receive their vascular nerves by way of the brachial plexus.

Since submitting copy for this paper I encountered an additional anomalous subclavian of the type described; moreover, William A. Hudson described a similar anomaly found in the anatomical laboratories of the Washington University, School of Medicine.

The writer wishes to express his deepest gratitude to Prof. J. Parsons Schaeffer for his interest in the preparation of this paper. Thanks are due to Dr. Clarence Hoffman for special dissections of the region.

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ACCESSORY PANCREAS WITH ULCER OF PYLORUS[1]

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THE most common anomaly associated with the pancreas is the presence of an accessory pancreas (1 and 2). A review of the literature shows this condition to be of not infrequent occurrence. It is found most often in adults, but Hess (3) reports one in an infant 3 months old.

Accessory pancreas may be considered under the following headings: (1) embryology, (2) anatomy, (3) histology, (4) pathology, (5) clinical, and (6) surgical.

Embryology. There are two theories for the development of the accessory pancreas. According to Ruediger (4) the pancreas is developed from three embryonic outgrowths, a dorsal and a right and left ventral. The two ventral unite early and give rise to the greater portion of the pancreas and the main excretory duct (Wirsung). The dorsal one fuses with the other later and gives rise to the head of the gland and the duct of Santorini. The failure of union of any of these three portions, with independent development gives rise to an accessory pancreas. This will explain the occasional presence of two accessory pancreases in the same patient. According to Opie (5): "At a very early period of embryonic life a lateral branch of the pancreatic duct entangled in the mesoblastic layers of the intestinal wall, is by longitudinal growth of the intestine, carried a variable distance from the pancreas and a new duct is formed in much the same way that the pancreatic duct regenerates after section." Mann (6) describes a case in which an accessory pancreas was found in a dog.

Anatomy. These tumors are usually situated between the serous and mucous coats in some part of the gastro-intestinal tract. In about one-third of the cases, it is situated in the

[1] Presented before the Clinical Society of the Peoples Hospital, December 14, 1921.

Fig. 1. Peritoneal surface showing large mass.

wall of the stomach near the pylorus; most frequently it is found in the first 8 inches of the jejunum. Other locations are the duodenum, lower jejunum, ileum, mesentery of the duodenum, the fat of the great omentum, hilum of the spleen, splenic capsule (7), and umbilical fistula. There is no connection with the pancreas proper, and it has a duct of its own. The pancreas itself is usually normal.

Histology. The histology usually resembles typical pancreatic structure. In a large number of cases, however, there are no islands of Langerhans. There are well-defined ducts and one main duct may be present. In all of the cases large bundles of smooth muscle fibers are present between the glandular structure.

Pathology. The mass is usually circumscribed, either circular or ovoid, from 2 to 6 centimeters in size and protrudes from the wall of the intestine as a hard nodule or occasionally projects into the lumen causing a narrowing. (Gibson, 8). The serous coat of the intestine always covers it. Inflammation is usually not present, but it is subject to the same pathology that affects the pancreas, i.e., acute pancreatitis with hæmorrhage and necrosis or chronic pancreatitis. On section the mass frequently resembles carcinoma.

Clinical. In only one case (Deaver's, 9) true diabetes mellitus was present, but in this case the condition of the pancreas proper was not known and in the accessory pancreas there were no islands of Langerhans.

Surgical. From a surgical point of view it is of considerable interest; it may cause diver-

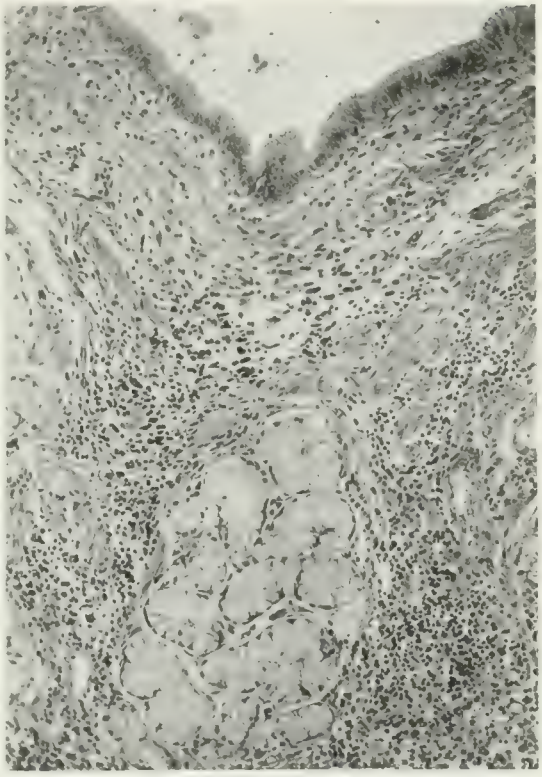

Fig. 2. Shows a portion of the aberrant pancreatic duct about to enter the mucosa, also ulceration of the mucosa above.

ticula of the intestine, obstruction, intussusception, carcinoma, ulcer of the pylorus and acute and chronic pancreatitis.

Relationship to cancer and ulcer. Nicholls (10) believes that these misplaced pancreatic "rests" are capable of independent growth and thus may subsequently develop into adenomata or carcinomata. This, however, is denied by most observers. Ewing (11) in his text book *Neoplastic Diseases* makes no mention of accessory pancreas. The relationship to ulcer of the stomach and duodenum is problematical. Deaver, in describing a case under his observation, states: "It is tempting to ascribe the presence of ulcer in this case to the pancreatic juice, but while ducts were present and many acini contained zymogen, it can never be known that actual pancreatic juice was secreted by this nodule." In most cases the cells appear normal and the assumption is that the cells do secrete.

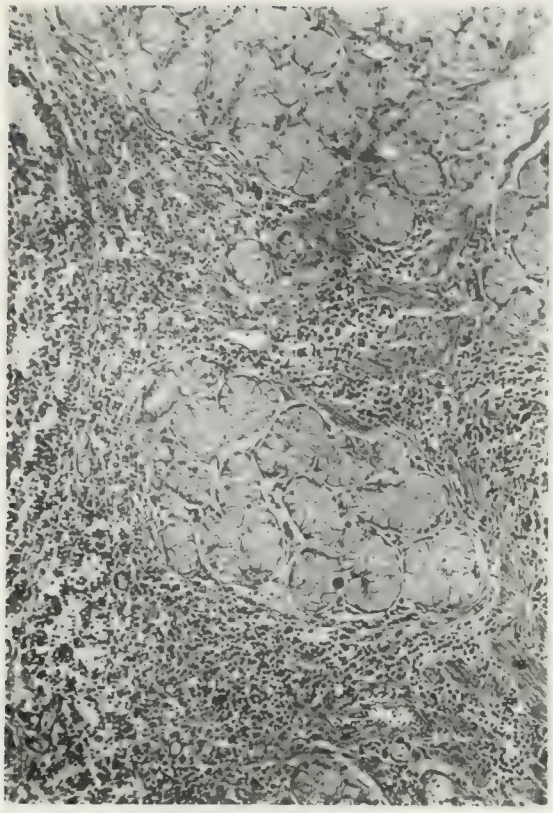

Fig. 3. More superficial areas of same showing more ulceration.

Fig. 4. Large areas of pancreatic tissue. In mass near the top are areas simulating islands of Langerhans.

Fig. 5. Large areas of pancreatic tissue.

Prognosis. The prognosis depends upon the condition of the gland. A small nodule without inflammation and causing no mechanical interference gives a favorable prognosis. Most often this condition is discovered only at the postmortem when death has occurred from other causes. In the cases of Nicholls, Hess, and Ruediger, the condition was so discovered. However, Benjamin's (12) case died 5 days after operation, Carwardine and Short's (13) 2 days and one of the two cases reported by Deaver in 6 days. The bad prognosis in these cases is usually due to concomitant inflammation and complications.

M. R., age 36, consulted me December 15, 1918. His chief complaints were nausea, vomiting, pain in the epigastrium, loss of appetite, and loss of weight. No hematemesis was present during the past year. His previous history was of interest. His gastric history dated back 5 years during which time he was treated for gastric ulcer in three large hospitals. The records of the third hospital showed that he was admitted on December 11, 1917. His chief complaints then were epigastric pains occurring one and one-half hours after meals, or independent of meals, radiating to left and back, burning in character and usually relieved by bicarbonate of soda. Pains were associated with vomiting, and occasionally his stools

were "black as coal." He also had slight tenderness and rigidity in the upper region of the abdomen but no masses were palpable. The roentgenogram then showed a persistent defect in the pyloric region, the duodenum was distended with the opaque meal and peristalsis was active. The 6 hour examination showed a residue on both sides of the pyloric sphincter. The radiographic diagnosis was pyloric ulcer. Gastric analysis by the fractional method (Rehfuss) showed free hydrochloric acid 60–70; total acidity 70–85. The other laboratory findings were negative, as blood, urine (no sugar), Wassermann, etc. No blood was found in the stool.

Several days following his admission to this hospital he vomited green and yellowish fluid and small particles of blood. He was fed through a duodenal tube. After 7 weeks of thorough medical treatment his ulcer was apparently healed and he was discharged. The symptoms, however, soon returned and on December 15, 1918, he consulted me. On examination an indefinite mass was palpable in the epigastrium. He was admitted to the Peoples Hospital, where I operated upon him on December 23, 1918. On examination, a growth the size of a hickory nut was found in the pylorus, causing considerable narrowing of the lumen. There were no other lesions in the stomach or duodenum, no enlarged lymph nodes, and the other viscera were normal. I performed a pylorectomy and posterior gastrojejunostomy. The postoperative course was uneventful. Over 3 years have now elapsed with no sign of recurrence of any of the symptoms.

The pathological report by Dr. Alexander Fraser, professor of pathology, University and Bellevue Hospital Medical College, follows:

"The specimen consists of a portion of pylorus and duodenum about 7 centimeters in length. In the wall involving equally pylorus and duodenum and bulging out over the external surface is a very hard spherical nodule about 3 centimeters in diameter. The mucosa overlying this area is depressed and granular in appearance. On the duodenal side is a small elevation with a central opening, which probing shows to be continued into the depth of the nodule. On section, the nodule presents a smooth, glistening surface showing whorls of stout fibrous bands, enmeshing numerous small areas which are softer and more granular in appearance.

"Histology. The nodule is composed of rolled and twisted bands of smooth muscle enmeshing numerous small islands of typical pancreatic tissue composed of acini and ducts. A few small groups of clear cells suggest, but are not true, pancreatic islands. Numerous ducts are seen coming from these nests of pancreas, traversing the musculature and converging toward a large duct which opens in the umbilicated elevation described in the gross. The mucosa over the nodule shows pyloric glands adjoining duodenum with typical Brunner's glands. The superficial layer involving papillæ and ducts is ulcerated, the glandular structures being absent and replaced by lymphocytes."

CONCLUSION

The presence of accessory pancreas is of considerable interest. Frequently associated with this anomaly are many developmental errors. Surgical complications, as obstruction, ulcer, intussusception, diverticula, pancreatitis, etc. are often present. The chemical irritation of the pancreatic juice on the tissues should be considered. In my case, I believe that this was the cause of the ulcer.

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STRICTURE OF THE URETER AS AN EXPLANATION OF SOME OBSCURE ABDOMINAL CONDITIONS[1]

By THOMAS M. GREEN, M.D., F.A.C.S., Wilmington, North Carolina

STRICTURE of the ureter occurs generally at one of three points, (1) just below the renal pelvis, (2) 3 or 4 centimeters below the pelvic brim, and (3) in the broad ligament portion. The latter point is by far the most common point of occurrence. Frequently there is a definite stricture at the broad ligament portion and also below the brim of the pelvis. The high situation is extremely rare.

Strictures are either congenital or acquired. The congenital strictures are considered rare by most authorities with the exception of Eisendrath (1) and Bottomley (2), who believe that they are far more common than one would be led to believe. On the other hand Hunner (3), Caulk (4), Furniss (5), Kelly (6), Garceau (7), and Braasch (8), all consider the acquired type by far the most frequent and regard the fœtal type as a rarity. The fœtal type is supposed to be due to the persistence of fœtal valves or to actual twists in the ureter, and is frequently associated with other anomalies of the kidney and ureter, such as failure of the kidney to ascend or to rotate. Both Eisendrath and Bottomley believe that fœtal strictures may exist for a long period of time and not show symptoms until adult life, that they are often multiple and the resultant hydronephrosis far more exaggerated than in the acquired type. Eisendrath (9) reviews some 67 cases which he considered congenital.

The acquired type may be of extrinsic or intrinsic origin. The extrinsic causes are pressure on the ureter from neoplasms, accessory or anomalous vessels of the kidney, traumatism of the periureteral tissue. The intrinsic causes are, tuberculosis, bilharziasis, calculus, malignancy, and pyogenic infection. The effects of neoplasms pressing on the ureter is not of very much interest as it does not occur often. This is probably true of anomalous vessels also. Ekehorn (10) first demonstrated the result of anomalous vessels pressing on the ureter and later W. J. Mayo (11) very elaborately reviewed this subject. They are most frequently anterior to the ureter and when they are they produce compession. When they are posterior they produce a kinking forward of the ureter. Injuries to the periureteral tissue frequently occur during pelvic operations, especially panhysterectomy. Tuberculosis may produce strictures anywhere in the ureter and they are most often multiple. In this instance, however, we are more concerned with the condition of the kidney than with that of the ureter. The strictures following bilharziasis are said to be also multiple and very pronounced. Dr. Wood and myself are attempting to prove the existence of this condition in North Carolina now. An impacted renal calculus may produce ulceration which may be followed by stricture. These strictures are invariably low down near the bladder. Primary carcinoma is very rare. Syphilis must always be borne in mind as a cause of ureteral stricture. Pyogenic infection is by far the most frequent cause of all strictures. Kelly (12) was, perhaps, the first to direct our attention to pyogenic origin of these strictures, his conception being that the stricture follows pyogenic infection in the urine. Hunner was the first to point out the rôle that focal infection plays in their cause and also that the infection is most often a blood-stream infection, and that the urine infection is secondary to stasis produced by the stricture. The route of the infection is most often by the blood stream, but it may pass upward in the lymphatic channels of the ureteral wall from below and sometimes through lymphatics which anastomose with those of the colon. It is possible for an infection to extend up along the mucous membrane of the ureter, but that is considered very unusual. The pathology of these strictures is similar to that of stricture elsewhere, i.e., connective-tissue proliferation and contraction. All coats are

[1]Read before the North Carolina State Medical Society, Pinehurst, North Carolina, April 26, 1921.

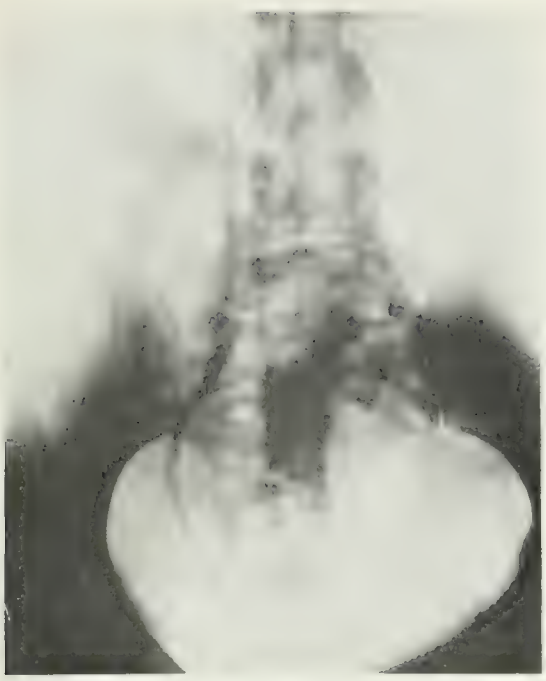

Fig. 1. Miss LeG., age 31. Abdominal colic at 6-month intervals for 3 years. Last one very severe. A most obscure abdominal case studied by internist, neurologist, and surgeon. No diagnosis made. Attacks began with desire to void, which gave no relief. Frequency of urination but not painful. Tender over ureter at pelvic brim. Marked nausea at end of colic attacks. With wax bulb found dense stricture in broad ligament portion of ureter (right). Moderate distention of ureter created the attack of abdominal colic. Further distention caused intense nausea. Similar condition in the left side. Focal infection, tonsils.

Fig. 2. Mrs. A., age 40, referred for abdominal adhesions causing the attack of pain, which was thought to be the result of renal colic. Has had appendix removed and uterus suspended, without relief. Duration of symptoms 10 years. Found stricture of both ureters and hydronephrosis. Both kidneys excessively movable, due to hydronephrosis. Focal infection, teeth and tonsils. Fluoroscopy shows no adhesions. No obstruction symptoms. Motile function of gastro-intestinal tract normal.

equally involved. It may vary from a simple annular narrowing to a marked area of dense infiltration in the ureteral wall. At first infection is deposited in the ureteral wall. The various coats are successively involved until the mucous coat is reached where ulceration soon occurs. The chloride constituents of the urine then set up a marked connective-tissue proliferation with resultant contraction. The colon bacillus, staphylococci, streptococci, and gonococci are the organisms most frequently found. Pyogenic infection sometimes produces a severe ureteritis, trigonitis, or urethritis without stricture and sometimes we find one or all of these conditions associated with stricture and dependent upon a focal infection (13) elsewhere. One frequently can trace attacks of urethritis and trigonitis to an outbreak of tonsillitis or other focal infection, which clear up with amazing quickness after removal of the focal infection. This is quite true with ureteral stricture and ureteritis.

The effects of stricture on the kidney and ureter are most striking and far reaching. Generally the effect on both is a gradual dilatation, but sometimes we see an atrophy of both. Barney (14) explains this with his experiments as follows: It seems that the question of atrophy or dilatation when the ureter is suddenly obstructed depends upon the accessory venous anastomosis through the renal capsule to the spermatic, infradiaphragmatic, ureteric, suprarenal, and subcutaneous plexus of the lumbar region together with other veins of that area. When the obstruction occurs suddenly there is a marked

Fig. 3. Mrs. Benton, age 36, referred for cholecystectomy. Cholecystotomy and removal of 256 gall stones did not give relief from pain along right costal border. Tonsils removed several years ago. Tender over gall-bladder area. Definite shadow in that area. Did cholecystectomy and appendectomy through right rectus incision. Had an attack of gall-stone (?) colic 6 weeks later. Stricture on both sides dilated. Capacity of 60 right and 80 left reduced to 18 in 6 weeks. Several bad teeth removed. Most marked result.

Fig. 4. Mrs. A., age 28, referred for acute appendix. For 10 years has suffered pain in right lower quadrant, with acute exacerbations. Condition called appendicitis by every physician who has seen her. Found pyelitis with temperature and leucocytosis. Stricture in brood ligament portion, etc., dilated with relief of symptoms. Capacity renal pelvis 60 cubic centimeters, reduced to 18 cubic centimeters in 6 weeks.

distention of the ureter and renal pelvis with a pronounced increase of intrarenal tension. The parenchyma shows an intense hyperæmia and œdema and since it cannot expand within the inelastic capsule the intrarenal pressure becomes so elevated that the venous capillaries of the parenchyma become obliterated. If the compensatory venous circulation through the capsule is sufficient, then we have a balanced circulation and continuance of urinary secretion with a hydronephrosis developing. If, however, this accessory venous circulation is not sustained then the intrarenal pressure becomes so great that it produces not only venous but arterial capillary obstruction, and secretion ceases with the resultant atrophy. In the gradual obstruction from stricture we have a continuous dilatation but gradual in character. There is, however, a marked increase of intrarenal tension and constant hyperæmia creating a larger and heavier kidney. It has long been considered that the hydronephrotic kidney is always the one to select for nephropexy. It would be well here to review the work of Edebohls on suspending kidneys. He found that after slinging the kidney to the lumbar aponeurosis by stripping off its capsule and using it as a sling the albuminuria and casts frequently disappear from the urine. This led to a very extensive capsule stripping of nephritic kidneys with more or less improvement, unfortunately of a temporary nature. While the removing of one inelastic capsule allowed the renal parenchyma to expand and to relieve it of the devastating effects of increased intrarenal tension brought about by hydronephrosis, it did not prevent a reformation of the capsule which invariably took place. Again McNider (15) has shown so clearly that mercurial poisoning will produce such

Fig. 5. Mrs. Way, age 41. History of long-standing attacks of pyelitis. Pelvic surgery advised from time to time, but refused. Dilated stricture right side below pelvic brim. Renal capacity 100 cubic centimeters, reduced by treatment in 7 days' time to 50 cubic centimeters and to 18 cubic centimeters after the third treatment, 2 weeks later.

Fig. 6. Miss Fickling age 17. Operated upon 2 years ago for acute appendicitis, no relief from the pain in right side until 2 strictures in right ureter were dilated. Focal infection, tonsils.

œdema of the renal epithelium as to create a marked increase in intrarenal tension and ultimately an anuria from obliteration of the capillary circulation of the parenchyma. It is also a recognized treatment for the anuria of mercurial poisoning to strip the capsule from the kidney with the hope of permitting the parenchyma to expand and the secretion to be resumed. In my recent observations I am finding a constant improvement in the functional test of hydronephrotic kidneys going hand in hand with the return of the dilated renal pelvis to normal. After dilating ureteral strictures we have also had some very encouraging results in lower blood pressure readings. Geisinger (16) lays great stress upon this question of intrarenal tension and he gives it first consideration in the sequelæ of hydronephrosis which follow stricture of the ureter.

SYMPTOMS

One of the most characteristic symptoms of ureteral stricture is pain. It is due most often to the distention of the ureter and renal pelvis from obstruction, and is therefore in a manner similar to the pain of renal colic, gall stones, and appendicitis. It may be acute or dull, constant or intermittent, referred to the pelvis, to the back, or along the course of the ureter. It may be referred to the opposite back, to the sacro-iliac, epigastric, and gall-bladder areas and ofttimes down the back of the thigh. This accounts for the condition being so frequently confused with appendicitis, gastric disorders, pelvic conditions, sacro-iliac joint diseases, and gall stones. Patients frequently complain of having had pain for years. It is often aggravated with each recurring attack of pyelitis or with the menstrual epoch. There is a milder type of

Fig. 7. Mrs. F., age 24, had had attacks of pain over gall-bladder area almost daily. Sometimes pain in costo-vertebral angle posteriorly. Diagnosis of gall stones and appendicitis made by numerous physicians. Always refused surgery. Very difficult stricture, 4 centimeters from bladder dilated. Capacity 100 cubic centimeters reduced to 55 in 1 week. Most marked improvement of symptoms. Distention of kidney with fluid creates so-called gall-stone and appendicitis attacks. Focal infection, teeth and tonsils.

Fig. 8. Mrs. Thompson, age 35, suffering for years with pelvic distress and backache. Has had some pelvic operation done several years ago. No relief. Definite stricture and double hydronephrosis demonstrated. Marked improvement in urinary functional test and lowering of blood-pressure readings. Albuminuria and granular casts disappearing also. Focal infection, tonsils.

pain in some cases, where little or no hydronephrosis exists and is due to stricture with marked ureteritis. Other symptoms of ureteral stricture are gastro-intestinal disorders, especially mucous colitis and conditions dependent upon chemical disturbances of the gastric juice. Less frequently there is mental depression with all sorts of nervous states, until we too frequently relegate these patients to the class of so-called neurasthenics.

The urinary signs are generally intermittent and consist usually of night voiding, day frequency, and tenesmus. They generally give a history of having had urinary symptoms existing over a period of years. Frequently they date from childhood. Cultures of the urine are as often negative as positive. I have always found them positive during acute exacerbation. The presence of pus or blood in the urine is uncertain. They are just as often absent as present, except during acute exacerbation. Fever may be present during the pyelitis attacks and generally indicate poor drainage of the renal pelvis. The mere insertion of a permanent catheter for 24 hours is apt to give relief.

DIAGNOSIS

Patients generally present themselves with a history of abdominal pain referred to one of the previously mentioned areas, with a history of having been operated on without relief. Hunner found that in a series of 50 cases, 34 of them had been operated on and of this 34, 7 operations were classified as necessary and 27 of them were unnecessary. One patient, 36 years of age, had spent the larger portion of the last 18 years in hospitals and had had 8 operations done, 7 of which were abdominal. The urinary symptoms and the urinary findings, if positive, are very helpful in the diagnosis. Palpation gives us a great deal of

help and reveals tender spots, corresponding with the stricture, i.e., low down in the broad ligaments or at a point 1 inch to the outer side of the umbilicus on a level with the brim of the pelvis. Sometimes the entire ureter is tender where ureteritis is marked and extensive. The kidney is often large and tender, readily palpable, and too freely movable. During palpation patients frequently complain of the character of pain that they have suffered from so long and pressure on the kidney and ureter frequently gives them a desire to void. Vaginal and rectal examinations also reveal tender spots in the lower ureter. The cystoscope often reveals valuable information. Often we find a marked urethritis and occasionally actual stricture which is always suggestive of a stricture of the ureter above. The vesical trigone is also often the seat of definite inflammation. The ureteral orifice is as often normal as diseased in appearance. The mons ureteri sometimes show a bullous œdema. The ureter may be so distended as to project into the bladder in a teat-like formation with ureteral orifice in its apex. The stricture may be so dense that obstruction to the catheter as it enters the ureter may be so definite that one does not pass it until several attempts have been made. When the catheter is passed a steady stream of urine is very suggestive of hydronephrosis and stricture. The normal rate of urine is drop by drop at the rate of 17 drops a minute. Another very definite diagnostic sign is the extreme pain when the catheter passes through the area of ureteritis or stricture, the patients often exclaiming: "Doctor, you are creating an attack." The free bleeding of the ureter from the mere passage of the catheter is another very suggestive evidence. Another valuable diagnostic aid is the distention of the renal pelvis and ureter with fluid and measuring the returned fluid. This should be done cautiously because the fluid may be forced into the parenchyma with more or less severe reaction. It should be discontinued as soon as the patient feels any pain in the back. They ofttimes warn you that you are creating the same pain from which they have suffered for years and refer to it by whatever it has been called in the past, whether it be gall-bladder pain or appendicitis or what not.

Fig. 9. Mrs. Fussel, age 50. Five years previously was treated for duodenal ulcer. Constant soreness and occasional acute pain over the gall-bladder area. Hyperchlorhydria, large, round shadow in the gall-bladder area. Fat woman, over 40. Dyspepsia for 10 years. Was being prepared for a cholecystectomy at that time. Found strictures in both ureters, but especially the right, marked hydronephrosis, with a capacity of the renal pelvis of 90 cubic centimeters right and 60 cubic centimeters left. Distention of the right renal pelvis with fluid creates the gall-bladder (?) pain. Focal infection, tonsils. One year later she developed an acute attack of appendicitis. At operation an acute appendix without adhesions was removed. The gall bladder was normal and there were no stones in the bladder or ducts. The stomach and duodenum were both normal and no evidence could be found of previous ulcer. Both the patient and myself were able to distinguish between this attack and her former one. But how easy to have erred. So we must consider ureteral stricture as a distinct diagnostic entity in not only chronic but acute abdominal conditions and especially where symptoms are referred to the right side.

Finally we come to the most definite means of diagnosing a stricture, that is, passing a catheter with a wax bulb. We may have obstruction going in, but there is so much chance of error that we do not consider that an evidence of stricture. However, if on attempting to remove the catheter we get a very definite hang and a grating sensation as

we draw the wax bulb through the stricture or have it come through with a jump, we have a very definite evidence of stricture. Finally a pyelo-uretergram serves not only to check up the question of hydronephrosis, but it demonstrates the presence of stricture and at what location. It may also show the presence of stone and help us determine a tubercular kidney from the other type. It is also useful for future comparisons. The passing of a catheter with a wax bulb should be done not oftener than once in 8 or 10 days, depending upon the amount of reaction after a treatment. The renal pelvis is irrigated through the catheter before it is removed. I use a 1 per cent nitrate of silver.

Very frequently a marked reaction after the gentlest sort of treatment is in itself a diagnostic evidence of ureteritis and stricture. However, there is a certain amount of reaction occurring after each treatment and it is only to the exaggerated type that I was referring above. There are certain precautions about these treatments which should always be observed. Treatments should not be given too frequently. It is well to withdraw the stilette an inch or two so by no possible chance could it be pushed through one of the eyes of the catheter and penetrate the ureteral wall. It is not well to use large wax bulbs, especially at first. Do not dilate strictures beyond 6 millimeters. The shoulder of the bulb should be tapering.

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RESULTS IN INTERPOSITION OPERATION FOR PROCIDENTIA AND PROLAPSE OF THE UTERUS

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THE interposition operation for procidentia and prolapse of the uterus was first described by Watkins (4) in 1899. Various modifications of the operation have been proposed, the best known being those of Wertheim (2), Schauta (3), and Freund (1). The details of the technique of the operation must be modified to suit the individual case, but in general we have adopted the following technique.

The cervix is seized with toothed forceps, and drawn well down; a transverse incision is made about 2 centimeters from the tip of the cervix through vaginal mucosa and fascia, just below the bladder reflection on the cervix; a vertical incision is carried up from its midpoint, in the median line of the vaginal mucosa, to a point 1.5 centimeters below the urinary meatus. The mucosa and subvesical fascia are dissected back in one flap on one side, and separately on the other. The mucosa is then resected back on the latter side to a point which can be reached without too great tension by the flap from the opposite side (Fig. 1).

The bladder is dissected free from vagina and cervix by blunt dissection until the peritoneal reflection is reached. All bleeding points should be controlled at this stage. The peritoneum is opened, the fundus is delivered, and the adnexa are examined for evidence of disease. If the patient is in the child-bearing period the proximal ends of the tubes should be resected.

To deliver the fundus, three figure-of-eight sutures of No. 3 formalin catgut are placed in the anterior wall of the uterus, the lowest about one-third of the distance from the internal os to the upper surface, the next 2 centimeters above, and the last about 1 or 2

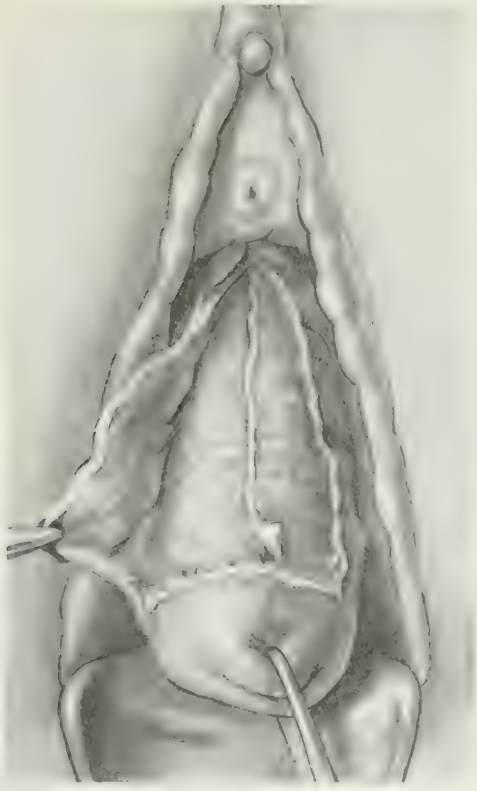

Fig. 1. Transverse incision through vaginal mucosa and fascia and vertical incision extending from midpoint of transverse incision to within 1.5 centimeters below urinary meatus. The mucosa and subvesical fascia are dissected back in one flap on one side, and separately on the other. The mucosa is resected back on the latter side to a point which can be reached by the flap from the opposite side.

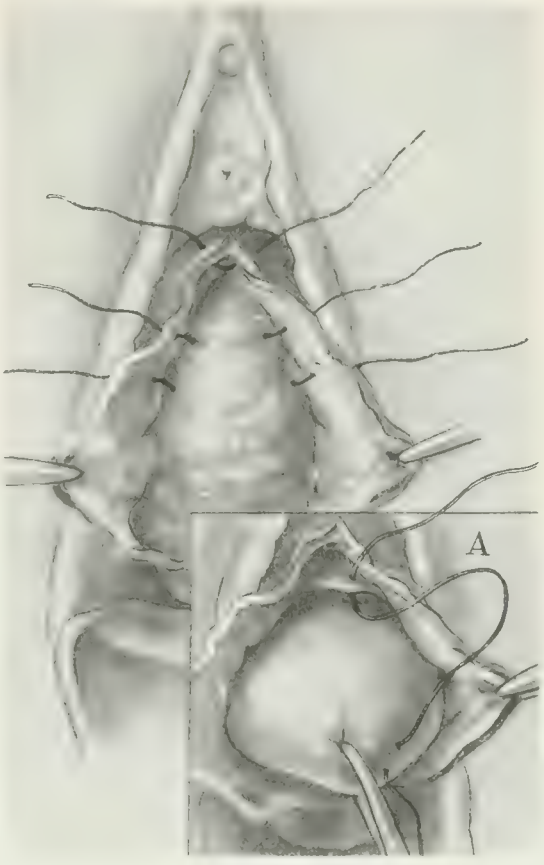

Fig. 2. The cut edge of the peritoneum is sutured with plain catgut to the upper surface of the fundus.

centimeters higher. The free ends of these sutures are passed from within outward through the lateral flaps of subvesical fascia but not tied until later (Fig. 3). The cut edge of peritoneum is sutured with plain catgut to the upper surface of the fundus (Fig. 2). The flaps of subvesical fascia are overlapped with mattress sutures, No. 2 chromic, and a few interrupted sutures of plain catgut used to approximate the cut edges of mucosa (Fig. 4). The traction sutures mentioned above are now tied, which approximate the anterior wall of the uterus snugly to the anterior wall of the vagina (Fig. 5). The method of delivering the fundus by traction sutures is Dr. Cullen's contribution to the technique of the operation. Where there is much hypertrophy of the cervix, it should be amputated. The operation is completed by a posterior perineal repair.

During the past year a patient, age 65, upon whom we had performed this operation 6 years before, was admitted on the gynecological service of the Johns Hopkins Hospital. A raw ulcerated mass projected from the vagina which proved to be the bladder with the uterus still in place below it. It was practically a prolapse of the whole pelvic floor. A section of the cervix, removed for microscopical examination, showed no malignancy.

This patient, a scrubwoman in the hospital, had had six children, and she boasted that "all of them came in the bucket." She seemed to take a special pride in having her children without medical assistance. At one delivery, when she was under the care of the outpatient obstetrical service of this hospital, she said she was only able to "fool the doctor" by telling him she smelt something burning down stairs. She immediately got out of

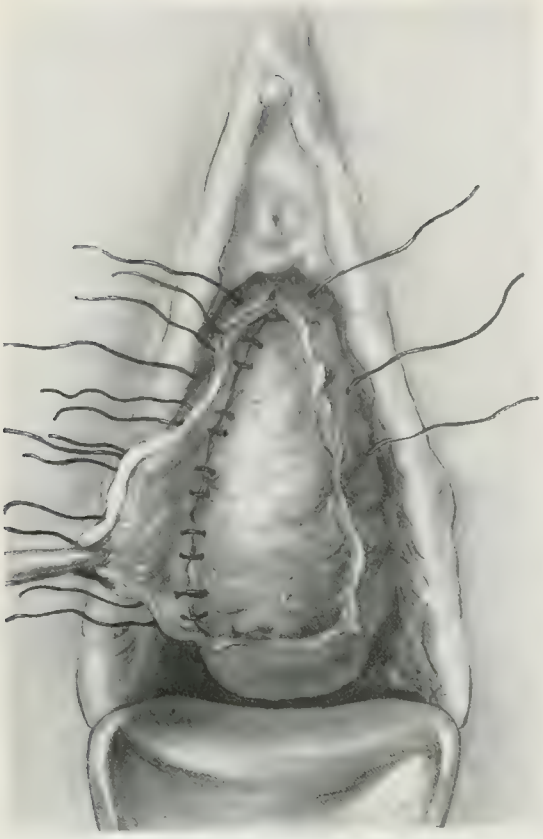

Fig. 3. The free ends of the three figure-of-eight sutures which have been placed in the anterior wall of the uterus, are passed from within outward through the lateral flaps of subvesical fascia but not tied until later.

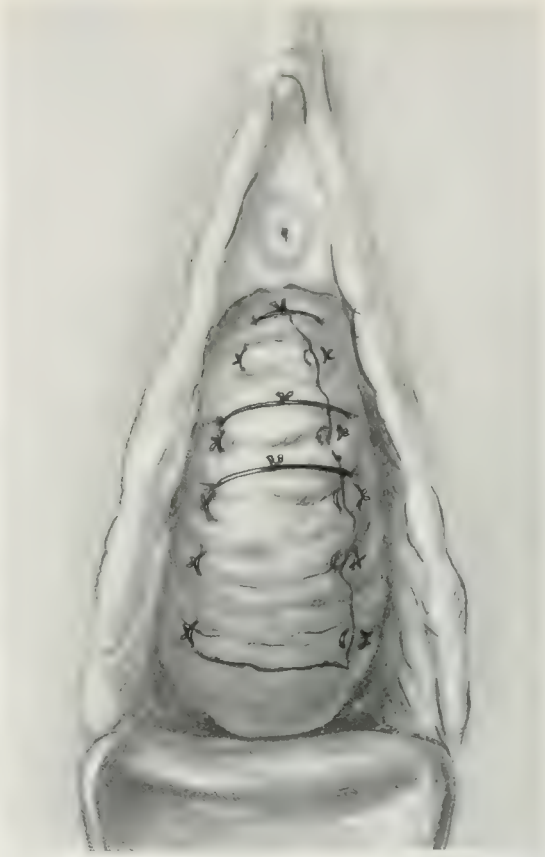

Fig. 4. The flaps of subvesical fascia are overlapped with mattress sutures and a few interrupted sutures of plain catgut used to approximate the cut edges of mucosa.

bed, and the baby was born before the doctor returned.

As a result of the repeated injuries to the pelvic fascia, and the heavy work of her daily routine, the support to the pelvic organs was practically destroyed. We decided to go in above and do a ventral fixation.

It was most interesting to see how easily the uterus could be freed from the surrounding structures. An objection that has been raised to the interposition operation is that it would be very difficult to treat a malignancy occurring later. We found it very easy to deliver and it was sutured with four silk sutures to the under surface of the rectus fascia just above its insertion into the symphysis.

Unfortunately, on about the sixth or seventh day, the patient raised the dressing and scratched the lower angle of the incision, causing an infection which traveled down to the silk sutures in the fascia, and necessitated their removal. The uterus must have become densely adherent to the anterior wall, probably as a result of the infection, for the mass did not protrude during the 5 months she was under observation.

The fact that prolapse had recurred in this case, led me to look up the results of the interposition operation in this clinic.

Since 1900, there have been 118 interposition operations performed. The majority of the patients were of the dispensary class, people who are constantly changing their addresses. Out of the whole number only 58 sent replies to the form letters sent out, or had been seen in the clinic after their operations. Of this number 40 had been completely relieved of their symptoms, 13 were not improved, 3 had died after leaving the hospital, and 2 died in the hospital. Of the deaths in the hospital, one was due to pulmonary

embolism occurring on the twelfth day after operation, and the other a fatal hæmorrhage from left uterine artery on the tenth day.

Dr. Watkins (5) in an excellent article on the technique of the interposition operation, makes the following statement: "The operation is limited to the treatment of patients near or subsequent to the menopause. It is useful in exceptional cases during the reproductive period where the prolapse is extensive and when pregnancy is impossible or inadvisable. This will necessitate excision of a portion of each fallopian tube to render the patient sterile."

To anyone familiar with the technique of the operation, the above dictum is self-evident, and yet the fact that it is overlooked is seen in the results in our cases. Two of our cases became pregnant after operation. One aged 37, was admitted to this hospital 14 months later with a pregnancy of about 4 months' duration, suffering severely. She came from Virginia and did not reply to my letter requesting details about her delivery and subsequent course. The other, aged 36, wrote that she "had a 10-pound baby 6 months after operation, and had a very hard time." Both of these operations were performed by one of the most experienced surgeons of our visiting staff.

The average age of the patients was 45. The ages of the whole series of 118 cases were as follows:

Under 20	2
20 to 30	8
30 to 40	24
40 to 50	46
50 to 60	26
60 up	12

Resection of the tubes in this type of operation in this clinic was first done by Dr. Kelly in 1908. In 35 operations done on women in the child-bearing period during the next 6 years, the tubes were resected only 4 times. Since 1914 only 9 operations have been done on women in the child-bearing period, 7 with resection and 2 without.

Our results, on the face of them, 13 failures out of 53 cases of which we could obtain records, are certainly not brilliant. This might be partly explained by the fact that, in the class of patients in our series, the majority of whom were of the dispensary type, we are more likely to hear of our failures than successes. Two of the failures were girls of 17, obviously not suitable cases for this type of operation. The average age of the failure was 38.

Fig. 5. The traction sutures mentioned above are now tied, thus approximating the anterior wall of the uterus snugly to the anterior wall of the vagina.

With increased experience in selection of cases in which the operation is suitable, and with suitable modifications of the technique in the individual case, much better results have been obtained, as we have only one failure reported since 1915. During this time 40 operations were done, 21 of whom sent replies to follow-up letters.

We feel that the operation is limited to a small group of cases, near or subsequent to the menopause, where an abdominal suspension combined with a thorough repair of the perineal floor, is contra-indicated.

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DEPARTMENT OF TECHNIQUE

INGUINAL HERNIOTOMY UNDER REGIONAL ANÆSTHESIA

A New Method of Field Block

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IT is usually conceded that local anæsthesia had its beginning in 1884 when Koller demonstrated the anæsthetic action of cocaine by instilling a 2 per cent solution into the conjunctival sac. Ophthalmologists were thus the first to make extensive use of cocaine anæsthesia; but the fact that any mucous membrane was rendered insensitive by cocaine soon led to its use by laryngologists and rhinologists. Rapidly following its success in these fields, experiments in other lines of surgical work were carried out, and it was soon found that the injection of cocaine solutions in the skin, as well as subcutaneously was almost immediately followed by a loss of sensibility to pain. The extensive use of the anæsthetic drug, in the absence of any serious study of its pharmacological action, gave rise to dangerous symptoms and many deaths, probably many more than were reported in the literature. Reclus and Schleich did much to overcome these drawbacks by the introduction of weaker solutions; but the type of anæsthesia thus produced was inferior to that obtained with the original solutions. Adrenalin solution 1:1000 was next added; this prolonged the anæsthetic action and decreased the toxicity of the drug, but not to an extent to make even the weaker solutions free from danger.

The possibilities of operating painlessly under local anæsthesia were thus demonstrated by the use of cocaine, and efforts were stimulated to find a substance which on subcutaneous injection would suspend sensation and at the same time be free from toxic effects. As a result a certain number of synthetic products were discovered which possess anæsthetic properties and toxicity in greater or less degree. Of these, only novocaine or procaine has proved to be of real practical value. This drug, first produced by Einhorn, in 1905, is readily soluble in water. Its solutions can be sterilized by a limited amount of boiling without undergoing any appreciable change. It is not irritating to the tissues, and is variously estimated to be seven to ten times less toxic than cocaine. Adrenalin added to novocaine solutions, intensifies the action of the anæsthetic drug and lengthens the duration of the anæsthesia by contracting the vessels and reducing the rapidity of absorption, so that a much weaker solution is required than when novocaine is used alone. The novocaine-adrenalin solutions have been proved to be the ideal anæsthetic and are employed to cover almost the entire field of operative surgery.

No less striking than the improvement in anæsthetic drugs has been the advance in the technique of their administration. The original methods practiced by Reclus, Schleich, and Halsted consisted of peripheral intradermal infiltration and massive œdematization with a dilute solution. The characteristic feature is that the site of injection lies along the line of incision and in the operative field. This procedure is still employed extensively for minor operations under local anæsthesia. Matas and Cushing first reported cases in which operation was performed by a "neuroregional" method, particularly herniotomies in which there was direct infiltration of the line of incision, and further injection of the parts during operation, in this manner attempting a perineural injection of the nerve trunks encountered at the upper outer extremity of the incision. This method probably remains the most popular among American surgeons who perform herniotomies under local anæsthesia. The next important departure came with the circuminjection of the operative field in which a wall of anæsthesia is made to encase or isolate the

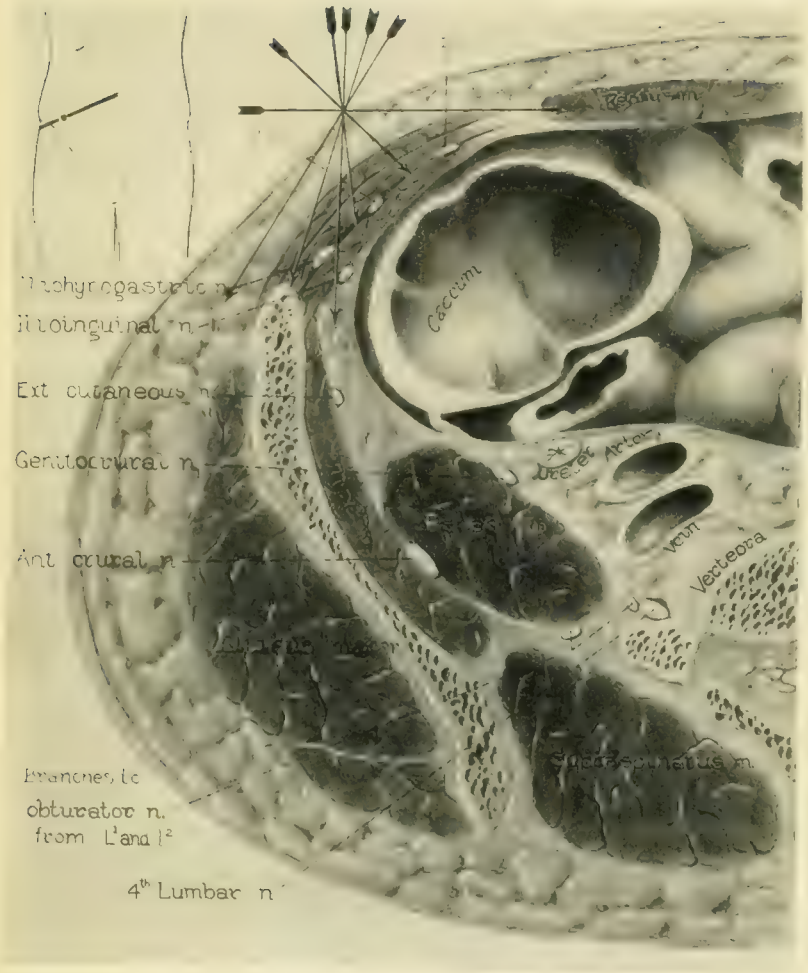

Fig. 1. Right half of oblique cross section of the abdomen passing through a point about 2.5 centimeters above and medial to the anterior superior spine of the ilium and umbilicus. Note the nerves and the manner of injecting through the para-iliac wheal *1*, in Figure 5.

operative area, a procedure known as field block. This principle was probably first practiced by Hackenbruch, and later popularized by Braun. True nerve blocking in herniotomy was practiced in 1911 by Laewen, who injected the nerves supplying the inguinal region at their exits from the intervertebral foramina. Thus the trend of progress in technique has been from peripheral infiltration through field block to nerve block, the last being the procedure of choice in all work under injection methods of anæsthesia. No matter how large the hernia may be, it is sufficient to inject the last three intercostal nerves and the first four lumbar nerves close to their exits from the vertebral column, a procedure known as paravertebral block (9). This procedure, however, is technically more difficult than regional block in which the nerves to the operative area are anæsthetized farther along their course.

In dealing with major operations, the successful application of regional anæsthesia demands patience, time, and skill, a skill that can be acquired only through practice on the human skeleton and human cadaver. The operator thus develops a knowledge of anatomy which enables him to visualize the nerve trunks to any region in relation to surrounding structures, especially to the bony prominences of the framework, which are his most reliable landmarks on the living subject. It is for this reason that regional or block anæsthesia appeals more forcibly to the well-trained surgeon, fresh from the anatomic laboratory, at a time when his volume of operative work is small, and he finds a very practical application for his topographic anatomy, which is a source of no small gratification. It is only through the aid of applied anatomy that regional anæsthesia has advanced to its present state of importance.

It is necessary for the surgeon operating under local methods to use an essentially different technique from that commonly employed under general anæsthesia. Speed must often be sacrificed to gentleness. The surgeon should be calm, content, and patient, in spite of occasional short delays. He must be skilled in clean operative dissections and refrain from unnecessarily pulling and handling the tissues. Failure is quite likely to result if the operator is not constantly engaged in this type of work, for he must have learned, above all things, gentleness, and must have acquainted himself with the sensibilities of the different tissues encountered in various operative fields. The occasional operator who attempts major operations under regional anæsthesia often courts failure.

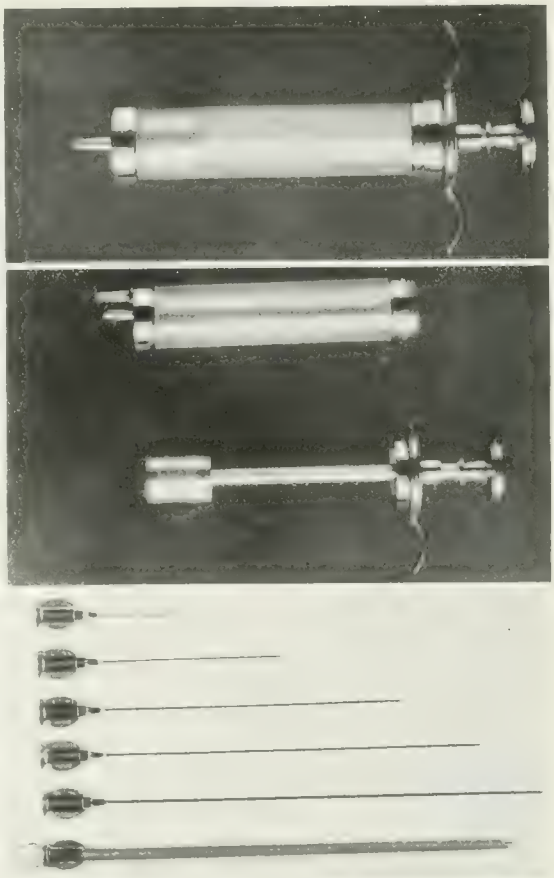

Fig. 2. Ten cubic centimeter special regional anæsthesia syringe.
Fig. 3. Syringe with two parts disconnected.
Fig. 4. Special regional anæsthesia needles.

It is important to inform the patient beforehand of the method of anæsthesia to be employed, especially of its advantages to himself. He should understand that the operation requires intelligent co-operation for his benefit. It should also be explained that when anæsthesia appears he will experience a sensation of weight and numbness in the region blocked and that pull and pressure of the parts may be felt, but that none of these sensations will be painful. The nervous apprehension natural in a patient about to undergo an operation may be allayed by a preliminary hypodermic injection of morphine, 1/6 gr., and scopolamine, 1/300 gr., an hour before the induction of anæsthesia. A drowsy, tranquil, mental state is thus substituted for one of uneasiness. A patient should then not be surprised by being stuck with the needle when he is not expecting it;

he should be informed when the needle is to be introduced.

The chief advantage of regional anæsthesia over general narcosis is its greater safety (6). Inhalation narcosis, especially ether, is ordinarily followed by nausea and vomiting, apart from the possibility of lung complications, thus, provoking considerable strain on the abdominal wall with consequent local pain and danger of overstraining the sutures and compromising the result. With regional methods, nausea, if it is present at all, is slight, there is no gaseous distention, and vomiting seldom occurs, thus leaving the sutures undisturbed. The diet of the patient need not be interfered with, as there are no disturbances of the gastro-intestinal tract. A light meal may be taken before operation, if operative conditions permit, and in most instances normal diet may be continued immediately after; in more severe cases it may be restored progressively in from 1 to 3 days after operation, according to the general condition of the patient and the type of operation performed. Stimulating drinks, such as coffee, may be administered immediately after operation. Regional anæsthesia thus avoids or considerably reduces the postoperative complications often produced by general narcosis, and as a result convalescence is shorter. Even after extensive herniotomy and repair under local anæsthesia, there is no disturbance of the pulse rate and blood pressure, and since the drugs employed at present do not have any deleterious effects on the kidneys, postoperative renal conditions usually do not occur. It is a great satisfaction for all concerned to have the patients come from the operating room feeling as bright as when they entered it.

The method of regional anæsthesia detailed herein has been devised to produce adequate anæsthesia for all types of herniotomy and repair, no matter what individual modification in operative technique is adopted. The anæsthesia is entirely distinct from the operation proper and is usually induced in a separate room, the patient being entirely anæsthetized and ready for operation on entering the operating room. The operation is, therefore, performed without loss of the surgeon's time and there is not the predisposition to infection from prolonged exposure of the wound, as in local infiltration (3). Anæsthesia remains complete for from 1½ to 2½ hours, so that the surgeon is rarely interrupted to make additional injections. The œdemitization of local infiltration also distorts the operative field (5), and the loss of solution considerably reduces the duration of anæsthesia, frequently necessitating further injection for the closure. In some instances there is a persisting serous discharge from the wound for 2 or 3 days (7) which prevents healing by first intention and predisposes to infection (8), a disadvantage which does not occur with the regional method. Keeping the solution away from the operative field also means anæsthetization of a larger area which permits greater retraction of tissues because of the greater muscular relaxation.

If a wall of anæsthesia is created obliquely across the anterior abdominal wall passing through a point about 2.5 centimeters above and medial to the anterior superior spine of the ilium and the umbilicus, the entire nerve supply of the operative area will be cut off, with the exception of the genitofemoral or genitocrural. At that level the eleventh and twelfth thoracic nerves as well as the ilio-hypogastric nerve lie between the transversus abdominis and the obliquus internus muscles relatively close to the iliac crest. The ilioinguinal nerve is still in the retroperitoneal tissue beneath the transversus abdominis muscle and at about the same level as the iliohypogastric nerve (Fig. 1). The genitocrural nerve is only accessible at the internal inguinal ring where it emerges with the spermatic cord.

TECHNIQUE

Unilateral reducible hernia. Anæsthesia is usually induced with 100 cubic centimeters of 0.5 per cent and 50 cubic centimeters of 1 per cent novocaine solutions in separate containers. Ten minims of adrenalin solution 1:1000, are added to each 100 cubic centimeters. Less solution is used for a lean patient. If the patient is very obese about 50 cubic centimeters more of the 0.5 per cent solution may be required, but in the average case a total of 150 cubic centimeters is never exceeded. The special regional anæsthesia syringe and needles introduced by Labat (Figs. 2, 3, and 4) are employed. The patient is placed in the dorsal decubitus position and the skin prepared as for laparotomy. The operator stands on the side of the region to be anæsthetized and with the smallest needle an intradermal wheal is raised at *1* about 2.5 centimeters above and medial to the anterior superior iliac spine; this is called the parailiac wheal (Fig. 5). A second wheal is raised at *2*, which lies just above the pubic spine; this is called the pubic wheal. The subinguinal wheal at *3* lies just below the inguinal (Poupart's) ligament and lateral to the femoral artery. With a needle 8 to 10 centimeters long and with an

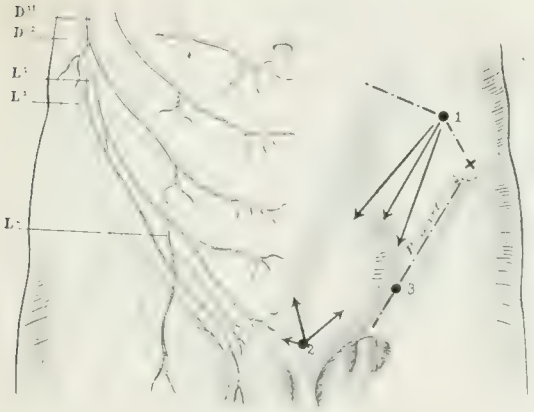

Fig. 5. Left inguinal field block for reducible hernia. *x*, Anterior superior iliac spine. *1*, Para-iliac spine. *2*, Pubic wheal. *3*, Subinguinal wheal. Note nerve distribution on the right side.

Fig. 6. Manner of injecting the cord while maintaining reduction with the last three fingers of the left hand.

equal mixture of the 0.5 and 1 per cent novocaine solutions fanwise injections are made down to the transversalis fascia in a plane perpendicular to the surface of the skin and extending from the crest of the ilium toward the umbilicus, the last injection being made just within the rectus sheath (Fig. 1). A subcutaneous injection then made in this plane creates a wall of anæsthesia which blocks the ilio-inguinal, iliohypogastric, and lower two thoracic nerves. Injection should be slow, steady, and continuous as the needle advances and is withdrawn. From 50 to 60 cubic centimeters of solutions is used in this injection in the average case. The needle is next introduced at the pubic wheel *2*, and deep injections into the pubic attachment of the rectus muscle on the same side are made, extending a little beyond the middle line, with about 5 cubic centimeters of the solution. Through the same wheal injections are made along the horizontal ramus of the pubis to a point 3 to 4 centimeters beyond the middle line, about 5 cubic centimeters of solution being employed for this also in the average case. The needle is next introduced at the subinguinal wheal *3*, deep injections are made underneath the inguinal ligament, followed by subcutaneous injections parallel with and along this ligament. The purpose of this injection is to control overlapping branches coming from the anterior crural and external cutaneous nerves and permit greater pull on the inguinal ligament in the approximation of the deep layers. About 10 cubic centimeters of the 0.5 per cent solution is needed for this.

If the hernia reduces spontaneously in the supine position, or if reduction maintains after taxis, the cord structures are next grasped between the thumb and index finger of the left hand at the external ring, or at the point the cord crosses the pubis, and the needle inserted through the pubic wheal. The position of the operator for the injection of the cord depends on the side to be injected, the injection being best made from the pubic spine upward. The cord structures are transfixed and injected with about 5 cubic centimeters of the 1 per cent solution, care being exercised not to traumatize the cord structures by multiple punctures, causing hæmatomata, which, however, are of no clinical importance. The cord is then massaged a little so as to hasten the diffusion of the solution.

The last injections are made at the margins of the internal ring. If the internal ring is easily found by the palpating finger, the needle is advanced from the pubic wheal in the subcutaneous tissue to a point just medial to the margin of the ring. The fascia is then perforated at this point and the injection made. Similar injections are made above and lateral to the margins of the internal ring, 5 to 10 cubic centimeters of the 1 per cent solution being used. If the internal ring cannot be located by palpation, the injections are made midway between the pubic and anterior superior iliac spines about 2.5 centimeters above the inguinal ligament. These injections surround the neck of the sac and are meant for blocking the genito-femoral nerve, but failure to anæsthetize this nerve occasionally happens, thus necessitating its injection after exposure of the cord.

Occasionally the reduction of the hernia is not maintained of itself, even with the patient in the

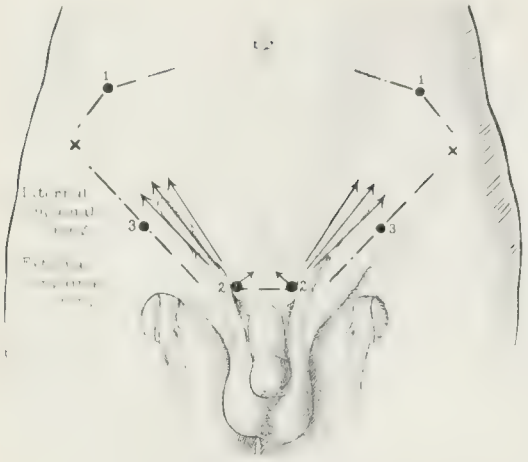

Fig. 7. Bilateral inguinal field block.

supine position, the mass reappearing as soon as the pressure is released. In such cases reduction is maintained with the last three fingers of the left hand while the cord is grasped with the thumb and forefinger and injected as previously described (Fig. 6). The injections around the internal ring are here best made from above through the parailiac wheal in order to prevent a possible puncture of the sac and its contents.

Bilateral reducible hernia. Figure 7 illustrates the bilateral block which is based on the principles described for unilateral herniotomy. The quantity of solution is 200 cubic centimeters of the 0.5 per cent and 50 cubic centimeters of the 1 per cent, with 20 drops of adrenalin in all. If more solution is required for very obese patients, the 0.5 per cent solution is preferable to the 1 per cent. The operation should be started on the side first injected. The results are identical with those obtained from unilateral block. Spinal novocainization is much easier and quicker, but the duration of the anæsthesia is only from 1 to 1½ hours.

Irreducible hernia. In irreducible hernia a different technique is employed to meet the resulting distortion of the region. Wheals *1*, *2*, and *3* are raised at exactly the same points as in cases of reducible hernia, unless the deformity of the region renders palpation of the pubic spine impossible, in which case the pubic wheal *2* is raised on either side of the hernial mass, but always level with the pubic bone. Wheal *3* (Fig. 8) is at the lateral margin of the hernial mass just below the inguinal ligament and lateral to the femoral artery.

Injections through the para-ilial wheal *1*, located about 2.5 centimeters above and medial

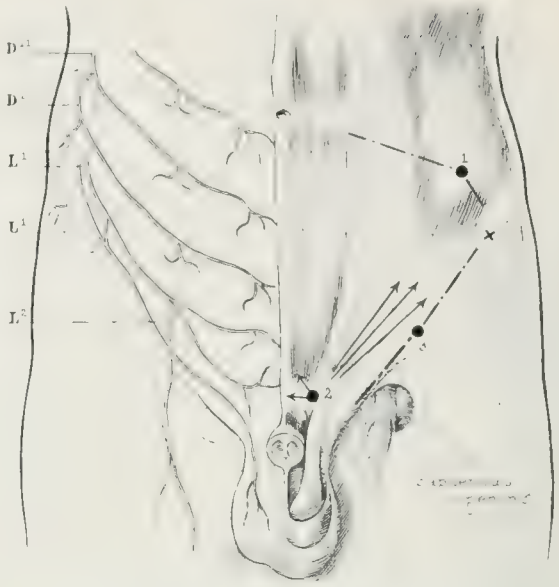

Fig. 8. Inguinal field block for irreducible inguinal herniotomy. *1*, Para-iliac wheal. *2*, Pubic wheal. *3*, Subinguinal wheal. Note injections of the internal ring from the para-iliac wheal.

to the anterior superior iliac spine, are made essentially as already described. Injections through wheal *2* are made along the horizontal ramus of the pubis and in the pubic attachment of the rectus muscle on the same side, but great care should be exercised not to transfix the hernial mass. Injection of the cord through the pubic wheal is not safe unless the parts held between the thumb and index finger at *2* are composed essentially of the structures of the cord. If there is any doubt of the presence of the sac among the structures grasped, deep injections, as well as subcutaneous injections, are made in the direction of the arrows from *2*, on both sides of the hernial mass, retracting the mass with the left hand to avoid its puncture. The cord is injected after exposure. Usually the genitocrural nerve cannot be injected from the pubic spine *2*, but the neck of the sac is infiltrated from *1*, as shown by the arrows; other injections are seldom necessary after exposure of the sac.

Strangulated hernia. A diminution in sensibility to pain accompanies strangulations. This is probably due to compression of the nerves and alteration in the blood supply of the strangulated area. Simple infiltration along the line of incision is all that is necessary; deeper injections depend on the pathological changes of the hernia and of the surrounding structures.

Inguinoscrotal and recurrent hernia. The same procedure is used as for unilateral inguinal herniotomy, but in old inguinoscrotal or sliding and recurrent hernia the cord structures are particularly difficult to block. It is, therefore, best to inject them after exposure unless the injections at the internal inguinal ring from the para-iliac wheal have been successful. With the inguinal incision it is not necessary to circuminject the base of the genitalia, as proposed by Braun, Pauchet, and others. Spinal novocainization is preferred in these cases, and when properly administered is as safe as the regional field block.

A little more time is required for regional anæsthesia than for the induction of general narcosis, but the advantages of the method greatly compensate for this insignificant loss of time. Usually no further injections are required, and no pain is experienced by the patient, provided the proper surgical technique is employed. A gentle, unhurried, and quiet technique is imperative, especially in dealing with the hernial sac. If the hernia is long standing, and especially if the patient has worn a truss, the adhesions are apt to be more extensive. The scalpel, instead of the scissors, is used for all necessary separation of such parts. Pulling and tearing are detrimental both to the patient and the method. After the sac has been opened, the contents may be pushed through the internal ring without causing pain, if it is done gently. If no pull or tension is exerted, adherent omentum and intestines may be separated painlessly provided no pull is exerted on the accompanying mesentery. Pain in inducing the anæsthesia is so slight that it need not be considered; it is caused principally by the initial entrance of the needle into the skin to raise the intradermal wheals. The complaint during operation, if any, is often from the cramped position and the tired feeling from lying on a hard table. The table should be well padded and there should be a comfortable pillow for the patient's head. His position should be easy and comfortable so that he will not wish to move for an hour. A tactful assistant should sit by the patient's head and engage him in conversation, sponge his face, administer small sips of water and in other ways contribute to his mental ease. Nervous apprehension may also be quieted by a calm demeanor on the part of the surgeon and his assistants.

INDICATIONS

There are no contra-indications to the use of regional anæsthesia except possibly in the very young patient. The regional method is particularly indicated in patients who have cardiac troubles, nephritis, pulmonary disease or any other condition that is not favorable to general narcosis, such as high blood pressure and diabetes. In the excessively obese patient spinal novocainization is preferable, because of the difficulty in injecting the deeper structures through the fatty layers. For strangulated hernia, regional or local anæsthesia is imperative, since the patient is in a very bad condition generally, and the added load of one-half hour to an hour under ether certainly should be avoided.

CONCLUSIONS

1. Regional anæsthesia with novocaine-adrenalin solution is the method of choice in inguinal herniotomy and should be used generally instead of only for patients who are unsafe subjects for general anæsthesia.

2. For inguinoscrotal or bilateral herniotomy in very obese patients, spinal novocainization is easier, quicker, and as safe as regional field block.

3. A hypodermic of morphine and scopolamine 1 hour before anæsthesia is induced is of aid in calming nervous apprehension.

4. The patient should be informed beforehand of the method and its advantages.

5. It is necessary that the surgeon's technique should be gentle and unhurried.

6. Every possible detail contributing to the comfort of the patient should be utilized.

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INDIVIDUAL DUODENAL X-RAY DEMONSTRATION

Three Case Interpretations

By HUGH W. CROUSE, M.D., F.A.C.S., El Paso, Texas

DIAGNOSIS of the pathological duodenum has, within the last few years, advanced to a marked degree. The duodenal tube developed by various workers has been the chief step in this special diagnostic progress. Schmidt's "Stool Studies," a painstaking technique, have furthered the knowledge of duodenal pathology, and at the same time have been of marked avail in classifying pancreatic deficiency. Serial X-ray gastro-intestinal pictures have also been of aid, demonstrating duodenal diverticula, ulcerations, and malpositions, whether developed through adhesions or congenital faults. The X-ray, though, as an agent, frequently fails to demonstrate duodenal pathology, due to the anatomical position of this structure below and in part posterior to the stomach. A barium or bismuth meal, fluid or solid, fills the stomach, opaques the structure, and in doing so, in the main obliterates the duodenum.

An attempt was made by the writer to obviate this X-ray diagnostic deficiency, and at the same time couple the diagnostic points available by the use of the duodenal tube, thus securing duodenal contents for analysis, and then, through the tube insert an opacous mixture for individualizing the duodenum by means of the X-ray. A case clinically giving a story difficult to differentiate as to the major pathology present, namely, gall bladder, pancreas, or duodenum, was utilized, and the following technique carried out. The duodenal secretions were collected for analysis, according to the Einhorn method.

The patient was placed in the upright posture for X-raying. A double intensifying screen 11 by 14 casett, containing a duplitized film, was placed anterior, tube behind, 22 inches, 1½ seconds, five and thirty exposure given. A beautiful demonstration of the tube within the stomach and duodenum resulted. With the patient still in the position for X-raying, a mixture consisting of 2 ounces barium sulphate 1 drachm malted milk, thoroughly blended, in six ounces blood-warm water, was poured through the piston-free barrel of the Rehfuss glass duodenal syringe. Development of the film showed a C curved duodenum, first third impinged upon by a seemingly enlarged gall bladder; a perfectly demonstrated,

Fig. 1. Case 1. Barium demonstration of duodenum immediately after passage into tube. See letter C type of duodenum.

Fig. 2. Case 1. Showing right renal and right pelvic fossa position of jejunum.

Fig. 3. Case 2. Tube coiled.

slightly dilated second and final third of the duodenum, and a left renal fossa located jejunum. The following day the laboratory report gave: specimen color, golden yellow; amylopsin, tryspin, steapsin, and bile present; no occult blood.

The clinical history of the patient, a female, age 43, was that for several years she had had right quadrant interval distress, gastric hyperacidity, frequent belching and bloating. The laboratory reported the duodenal secretion practically normal. The X-ray showed the duodenum, normal as to type, namely, the English letter C form, the duodenum ulcer-free, no diverticula, but a fair degree of dilatation of the second and third parts, with an impingement of the first third. These findings, when coupled with the physical findings, made the diagnosis seemingly clear. Murphy's percussion test was strongly positive. The Hook test was also positive. The Boaz back symptoms for common-duct involvement were absent. Thus, the physical findings, plus the laboratory findings, the X-ray interpretations of the duodenum proper and clinical history, gave confidence to the writer's conviction that the pathology was gall bladder primarily, duodenum secondarily. Surgical intervention was advised. Operation: gall bladder and appendix to be removed.

Case 2 had the following history:

Patient first seen in April, 1920. Male, aged 34, married, 1 child. Childhood and family history were negative. He was operated upon for appendicitis in 1909, for gall-bladder trouble in 1917. The chief complaint was: loose bowels with soreness in the intestines. This condition had been present for 10 years. Physical examination showed systolic blood pressure 100; extreme sensitiveness over sigmoid; particularly over caput coli; otherwise negative. Fluoroscopic examination showed ballooning of sigmoid, with sigmoid well over to caput coli region. Sigmoidoscopic examination revealed a dilated sigmoid, with the mucous membrane inflamed and thickened. The lower two-thirds of the descending colon were likewise observed, both accomplished by placing the patient in the Crouse

Fig. 4. Case 2. Fifteen minutes after use of atropine through tube.

reversed Trendelenburg position. The examination showed a follicular changed mucous membrane. Laboratory stool studies: no amœba, no intestinal parasite ova present.

Patient returned in February, 1921, and stated that he had been under observation at one of the large clinics for 6 months; condition seemed improved for a time then

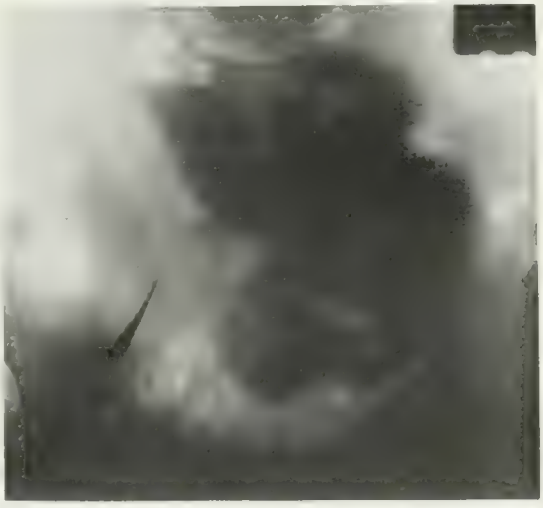

Fig. 5. Case 2. Barium filling of duodenum, demonstrating V-shaped duodenum and acutely angulated jejunum.

Fig. 6. Case 3. U-shaped duodenum in location of appendix and direct dropping and acutely angulated jejunum.

without warning former trouble came back. Patient was placed on medicinal treatment and diet.

He was seen again in June, 1921, giving a history of increased weakness, marked loss of flesh, and asked that something be done for him. Story of being unable to retain food, intense distress a couple of hours after food, with frequent stools, suggested duodenal investigation, and individual X-rays of that structure.

The roentgenogram in this case have been used in full to illustrate the difficulties in securing the tube's passage into the duodenum as well as demonstrating the diagnostic aid of the method. (See Fig. 3 to 5). In Figure 3 the tube is coiled. Figure 4 was taken 15 minutes after the use of atropine through the tube. Figure 5 shows the barium filling the duodenum, demonstrating a V-shaped duodenum, and an acutely angulated jejunum. The latter instead of physiologically sweeping into the left renal fossa has been pulled by caput coli adhesions into a right pelvic fossa, a pathological position. The appendix had been removed 12 years previously and the gall bladder 8 years ago to correct the diarrhœa, but each operation so far as correcting the trouble was concerned had proved unavailing, and possibly had caused adhesions and intestinal malposition, so that the diagnosis of case seemed logically to be neurotic diarrhœa. Theories of etiology could be based upon the following physiological points: Keith nerve node irritation, and through such a failure of the physiological bowel block action accompanied by an increased vermicular peristaltic wave in the small intestine, considered by Mall pathological. Carey's recent publication of his anatomical studies of the muscular and submucosal connective-tissue layers of the small bowel, show that each are left helicoidal, the outer muscular taking from 200 to 500 millimeter to complete an individual spiral muscle length, the inner muscular fibers 0.5 to 1 millimeter in spiral length, the submucosal connective-tissue fibrils having an outer spiral layer of 4 to 10 millimeters in fascicular length, and an inner spiral layer of .5 to 1 millimeter fascicular length. Each of these layers has perhaps a plexus control, the muscular that of Auerbach,

Fig. 7. Case 3. Tube in the duodenum.

the submucosal connective-tissue Meisner plexus. Both layers being susceptible to persistent toxic irritation and cicatricial tissue blocking, thus neutralizing the normal intestinal diastalsis (Cannon) as well as overstimulation of the mysenteric reflex (Cannon), would produce a neurotic diarrhœa, or intestinal hypermotility. Theoretically, these physiological points, neutralized, explain the pathological symptoms of the case. As to treatment subsequent to the above deductions, it seemed logical to avoid for the present surgical intervention, in spite of the adhesions demonstrated. Treatment: combined climatic, medicinal, and diet. Climate: a cool, moist environment, to be found either at high altitude or on the beaches of California, so well demonstrated by pediatricians as of avail in correcting the intestinal troubles of infants. Medicine: three valerinates. Diet: Milk and the prepared foods found advantageous in treating the intestinal tract troubles of early life. Should such treatment not prove effective, then surgical intervention.

Case 3. Male, age 39, occupation, broker, chief complaints: an intense intestinal stasis dating back 15 years. Most drastic purgatives were necessary to secure bowel movements. He had been in the hands of the leading New York and Chicago stomach specialists, and at one of our leading clinics repeatedly, with no improvement. He thinks he has appendicitis and intestinal adhesions. He has distress 2 to 3 hours after food. Percussion test and Rovsing sign positive for ptosis of stomach.

Indications: Duodenal investigation. Pictures were made subsequent to duodenal content removal. Laboratory report gave normal amylopsin, trypsin, and steapsin, no occult blood; bile present; culture negative.

Figure 6 shows a U-shaped duodenum, in the location of the appendix, or McBurney's point, and a direct dropping and acute angulated jejunum. As X-ray showed a normal filled and emptied appendix a diagnosis was made in this case of stasis produced by U-shaped duodenum—thus explaining the presumable appendicular pain—and a direct dropping and acutely angulated jejunum.

The following treatment was advised in this case: duodenal lavage, and the use of the Metzler magnesium sulphate solution, popularized by Lyon, with corrected diet. No operative procedure.

The features of the technique that have been found essential are as follows: After the duodenal

tube has passed into the stomach, curling of the distal end at times will occur. Particularly is this liable when pylorospasm exists. An ulcer of the duodenum close to the pyloric sphincter stimulates muscular contractions of the helicoidal fibers. Resistance to the pyloric stomach end wave develops, and the metal end of the tube remains in proximity to the pylorus, the last few centimeters of the tube curling in one or more whirls. After waiting 20 minutes, the patient having been on the right side, semi-prone position, during this time, and no duodenal contents having started to drain from the proximal end of the tube, the patient should be fluoroscoped to locate the pylorus and the distal end of the tube, the latter serving to demonstrate the former. With the patient in the upright position, an 8 by 10 roentgenogram should be made over the area, on tube located by the fluoroscope, and if the former is shown curled, a slight mouth withdrawal of the tube, and the following medicinal agents used:

A one-third grain tablet of novocaine should be dropped into the empty glass syringe part of the tube. A half ounce of warm water poured into the syringe will dissolve the tablet and carry it to the pyloric end of the stomach. While this is being done, the patient should be on the right side, semi-prone position (Grant's position). Ten to 15 minutes have proven ample in the writer's experience, subsequent to this medicinal application to the pylorus, for the latter to be anæsthetized, to dilate and permit the metal bulb to pass. Proof of this is the draining of the golden yellow duodenal contents from the proximal end of the tube. Atropine sulphate, $^1/_{150}$ grain, administered through the tube as in using novocaine, has also proven successful in securing the tube's passage into the duodenum, when such resistance is demonstrated.

The collection of the fluid should be made, an attempt to secure 30 to 60 cubic centimeters being best for the chemical and microscopical studies. A delay of duodenal flow through the duodenal tube when same is proven in duodenum, can be stimulated by lavaging duodenum with a small quantity of Metzler's magnesium sulphate solution. Gravity drain instead of attempt to aspirate is preferable, as aspiration has a tendency to suck the mucosa into the metal bulb orifices and give a misleading occult blood finding. The patient should again be skiagraphed, a 11 by 14 film, double intensified screen cassett being best. The film is developed showing tube within the duodenum. The patient in the meantime can remain stationed for skiagraphing. Utilizing the barium mixture, a serial, stereoscopic group of three pictures, 15 to 20 minutes apart, should be made.

All X-ray demonstrations of the duodenum, fluoroscopic or roentgenographic, should be carried out with the patient in the standing position. The prone posture compresses and blurs the picture.

A roentgenogram 8 by 10 is best proof of duodenal entrance of tube. Contents should be collected preferably after the roentgenogram shows position of the tube in duodenum proper, rather than depending upon the alkalinity and presence of golden yellow fluid which is alkaline. Regurgitation of the duodenal contents into the stomach sometimes misleads.

A short piece of hollow tubing, semi-vulcanized rubber drain, caliber ample for the passage of duodenal tube, or an old hard rubber thermometer case, cut in two, through which the duodenal tube can pass freely, inserted between lips and teeth of patient, proves of aid. A patient unconsciously either tightens the lips or bites the duodenal tube, thus restricting the gastric peristaltic tug upon the duodenal tube in the stomach's efforts to force the tube's metal end into the gut.

The diagnostic points available by this individual duodenal barium demonstration are portrayed in roentgenograms published with this article.

Its chief diagnostic features are as follows:

1. It is the individualizing of a difficult-to-demonstrate structure.

2. Chemical and bacteriological simultaneous studies can and should be carried out while X-ray plate interpretations are being made.

3. There is naught that is difficult in the dual technique, namely, passing of the duodenal tube and the individual roentgenographing of the duodenum. The X-ray operator can do both. Laboratory tests can be made by any physician who will make the effort to familiarize himself with Einhorn's technique, and equip himself with the necessary chemical agents for carrying out his instructions.

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ŒSOPHAGECTOMY

By STERLING BUNNELL, M.D., San Francisco

THERE is on record only one case of a cure of carcinoma of the thoracic-œsophagus—Torek's, in 1913. This patient is alive today, 7 ½ years after operation. Next to this case in degree toward success comes that of Bengolea (1919), which lived 37 days after operation. The tumor in the latter case was located 2 centimeters from the diaphragm, thus allowing an anastamosis to be made between the end of the œsophagus and the stomach. Willy Meyer reports a case which lived 7 days. This also was of the lower third. In the case to be reported, the cancer was located behind the arch of the aorta and bifurcation of the trachea. The patient lived 6 days after operation, which, for a cancer of the middle third of the thoracic œsophagus, is as long a period as any I find in the literature, with the exception of Torek's. A fatal infection here was inevitable, as the tumor, which was unfortunately too far advanced, ruptured during removal and contamination resulted. However, certain points were gained in this case which warrant recording.

Mrs. L. A.; age 32 years, a patient of Dr. E. J. Ghidella. Patient had difficulty in swallowing and pain behind sternum for 4 months. Weight was reduced from 105 to 74 pounds. X-ray showed constriction of the thoracic œsophagus opposite the third and fourth dorsal vertebræ. On August 3, 1920, a gastrostomy was done and the patient gained 10 pounds, but soon stopped gaining.

Operation. August 25, 1920. The dangers and probability of failure were fully explained to the patient and her family, and they chose to take the slight chance for success. Through a small preliminary collar incision over the episternal notch, blunt dissection was carried down to the side of the œsophagus. After making a long intercostal incision in the sixth left interspace and checking all bleeding, positive pressure by the method described by me in 1909 of using nitrous oxid and oxygen was applied and the chest was opened widely with a rib spreader. The patient's condition showed no change on opening the chest. Dr. Edith H. Williams administered the anæsthetic and positive pressure, as she had done many times previously in chest work, and kept the patient in good condition throughout the operation. The chest was open for 1½ hours, during which time the circulatory and respiratory conditions remained good and the inflation of the lung was always under accurate control.

The lung was adherent densely in its posterior half and apex. By scissor and blunt dissection it was entirely freed. The inferior ligament of the lung was split up to the hilus. A small vein in its lower border needed ligation. Retracting the lung forward, a lateral incision was made to the œsophagus in its lower third and by blunt dissection, keeping close to the œsophagus, the latter was easily shelled out of its bed and from the œsophageal plexus. As the left vagus still runs in a single trunk and is rather anterior here, the only branches of the œsophageal plexus cut are twigs to the œsophagus itself. This had no effect on the patient's condition. Holding the loop of œsophagus with a tape, the finger very easily freed the œsophagus from its bed down to the diaphragm and up to the cancer, which was behind the arch of the aorta. Luckily, the periœsophageal tissue is quite loose to allow movements of swallowing. The cancer could be felt as a smooth hard cylinder. It was somewhat adherent to its surroundings, but the adhesions yielded to finger dissection. Unfortunately, the cancer was already too far advanced so that it broke as it was being freed and its foul contents escaped into the mediastinum. This determined the fate of the patient, as it made infection inevitable.

It was then necessary to attack the tumor from above downward. Through an incision in the pleura above the arch of the aorta and superior intercostal vein and behind the subclavian artery and trachea, a loop of œsophagus was separated out, being very careful not to injure the thoracic duct, which was at its left edge. This was done under the eye by using a small, shielded, extension light within the thoracic cavity. With the finger, the œsophagus was easily dissected downward along the tumor behind the aorta until it was entirely free. Separation of the œsophagus up into the neck was done by a wire bent like a vein stripper. The bleeding that resulted was slight and entirely absorbed by one abdominal sponge.

After severing the œsophagus 2 inches above the diaphragm, its lower end was inverted with two purse-strings of catgut. The finger was thrust from the superior mediastinum up into the neck incision, and the œsophagus was drawn up and out through this incision. The tumor was cut off and the end of the œsophagus was passed subcutaneously down the chest for 2 inches and sutured there to an opening in the skin. The upper pleural wound above the arch of the aorta was carefully closed. A drainage tube was sutured to the lower hole in the mediastinum and brought out through a lateral incision, after resecting 1½ inches of the eighth rib for this purpose. The intercostal incision in the sixth space was closed with figure-of-eight encircling sutures. A rubber dam was placed over the drainage hole and positive pressure was discontinued. The operation lasted 2 hours and 15 minutes. A transfusion of 900 cubic centimeters of blood was done. Pulse was 124 and fairly strong, and her color was good.

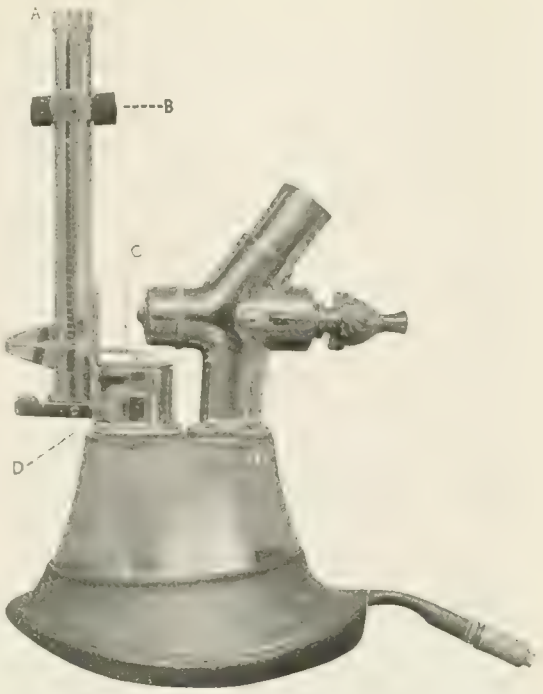
Post-operative. The condition remained good, the pulse was rapid, 130 to 140, but strong, evidently influenced by the effect through the vagus, as the color was red and the respiratory rate was 17, and the patient did not look sick. On the fourth day infection began to show itself and increased rapidly in spite of irrigation with Dakin's solution. Death occured at the end of the sixth day from pyothorax and mediastinitis.

Postmortem. A gray membrane of infection lined the left pleural cavity and lead into the posterior mediastinum and up to the site of the cancer. No other infected area was present. The lung was adherent where the adhesions had been cut. The upper wound in the pleura covering the superior mediastinum and the neck wound were closed and showed good healing. The lower stump of the œsophagus was sealed over and had remained well closed. The intercostal incision in the chest-wall had been healing *per primam.* Death was caused from pyothorax and mediastinitis.

Torek's paper in the *Annals of Surgery*, April, 1915, is so complete that only certain points and those gained from this case need be mentioned.

A simple long intercostal incision in the sixth or seventh space gives sufficient exposure and obviates the added shock of transcostal extension. As intrathoracic œsophageal anastamoses have never been successful, it is necessary to remove the upper end of the œsophagus and bring it out through the neck. As the free œsophageal end is prone to necrosis it should not be freed in the neck higher than is necessary and should not be carried subcutaneously down the chest for more than a few inches. Special care should be taken to avoid a kink where the œsophagus passes over the episternal notch. The closure of the lower stump of the œsophagus by two invaginating catgut purse-strings is satisfactory. An incision through the pleura above the superior intercostal vein greatly facilitates the removal of the upper end of the œsophagus. Here the dissection should be done by sight to avoid injuring the thoracic duct, which lies just to the left of the œsophagus. A small sterile extension light with eye shield can be placed high inside the chest cavity and makes work in this region easily possible. Great care should be used in closing the high incision in the pleura, so as to separate the neck wound from the pleural cavity, as cases of death from air leakage through the neck have been reported.

A lateral incision to the lower third of the œsophagus, through the œsophageal plexus, is without danger and does not affect the pulse, because only those nerve twigs are cut which go to the œsophagus itself. Interference with the vagus above the fifth dorsal vertebra is not so safe. Severing of both vagi above the heart causes instant death. Tugging on the thoracic aorta weakens the pulse. Drainage of the pleural cavity should, I believe, be avoided. Probably the best result will be obtained by closing off the pleura entirely and running a catheter drain from the œsophageal bed in the mediastinum subpleurally down through the diaphragm and out through the front of the abdomen above the stomach. This will prevent a hæmatoma in the mediastinum and can be withdrawn in 24 hours. If fluid collects in the pleural cavity it may be aspirated, and if it should become purulent the Mozingo treatment could be applied. It is possible that the best procedure is to leave postoperatively a closed pneumothorax, thus applying the method of Morelli in handling lung wounds, which avoids the aspirating effect of negative pressure on raw surfaces. I would strongly advise against the use of petrolatum in all lung work.



Showing mask for nitrous oxide and oxygen anæsthesia and snapped to the stem of its exit valve a spring device, *a*, which raises the pressure so as to prevent collapse of the lungs in operations within the thorax. The spring device is the only special apparatus needed for a positive pressure. *b*, Slider; *c*, lever pressing on slider; *d*, snap clamp on valve stem.

A great help in an operation of this magnitude is an immediate transfusion of blood, whether or not it is apparently needed at the time.

It is possible in some cases to perform an intrathoracic operation without differential pressure. I am convinced that it is not justifiable to do so unless from necessity. Without the use of some pressure method, the great labored respirations that occur when the chest is open cause the mediastinum to flap violently from side to side, causing shock. This, together with the lessoned ventilation and consequent strain on the circulatory apparatus, adds very materially to the hazard of an operation within the chest and is entirely and easily preventable by the use of differential pressure.

METHOD OF DIFFERENTIAL PRESSURE

A cabinet with a collar interferes with the neck part of this operation. Positive pressure masks have failed because ether has been the

anæsthetic and it necessitates removing the mask occasionally, because of vomiting, mucus collecting in the throat and falling back of the tongue. If nitrous oxid and oxygen is used the mask need not be removed during the whole anæsthetic, and the positive pressure is furnished from that under which the gases are stored in their cylinders.

A constant slight pressure equal to the elastic contracting forces of the lungs is constantly and evenly maintained by a simple spring device that is attached to the exit valve of any of the stock masks used with this anæsthetic. The degree of inflation of the lungs is always under the control of the anæsthetist, who can gauge it to a nicety by a sliding button on the spring. This method was first described by the author in 1910 and later in the *Journal of the American Medical Association* of March 23, 1912. I have used it many times and in some of the cases, such as an œsophagectomy by Dr. Henry Barbat both pleural cavities were open. The method has always been entirely satisfactory and has proved to be safe, simple, and efficient. Compared with the method of intratracheal insufflation, the complication of catheterizing the trachea, with its attending difficulties and dangers from bronchitis to pneumonia, are avoided, and we are able to use instead of ether the anæsthetic of choice for lung cases.

CONCLUSION

It is possible to remove successfully the thoracic œsophagus for some non-malignant conditions and for carcinoma in a very early stage only. Great faith is necessary on the patient's part to face such an operation at a time before his symptoms have proven to him the seriousness of his condition. Still this is the only time when a removal of the œsophagus for cancer can be successful. The first symptoms are usually pain and obstruction in swallowing. The pain comes when the free upward and downward excursion of the œsophagus in the act of swallowing is interferred with by œsophageal attachments. These symptoms even in their commencement denote a fair degree of advancement of the carcinoma. Prompt diagnosis by tissue section at the very onset of symptoms may make it possible to operate at a time sufficiently early to give the patient a chance for cure.

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EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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MARCH, 1922

TEACHING OF CLINICAL SURGERY TO UNDERGRADUATE STUDENTS DURING THE REGULAR ROUTINE OF HOSPITAL WORK

ASIDE from the systematic teaching of surgery in the medical schools, consisting of classwork quizzes, small group clinics, ward walks, general clinics, lectures, reviews and so-called seminar work, the student should have the benefit of personal contact with surgical cases before, during, and after operations, if this can be arranged without harm to the patient and without a waste of the student's time.

During the past 22 years we have experimented in my service at the Augustana Hospital with a system carrying out this idea, and it has proven of very great value to students who have finished their second and third years in various medical schools.

Every one of the young men who has taken part in this work has assured us that the plan has been of great value in his education. It may consequently seem proper to describe the plan in detail so that it may be tried in other institutions.

Each student is assigned to an individual interne for a period of not less than 3 months, during which time he works constantly under the direction of the same interne. He reports to his interne every morning at 7:30 and works with him under his personal supervision during the entire day, so that he shares all of the experience of the interne and has the privilege of asking questions and receiving the explanations offered throughout the day's work. He accompanies the attending physician or surgeon when the latter visits his patients in company with the interne, and is present at all the clinics in which the interne assists and performs minor parts of the necessary assisting under the direction of the interne. He is present during the examination of patients, and records the histories dictated by the interne or the staff member, as the case may be. He is present at all consultations and conferences and assists in the laboratory work connected with the cases under the care of the interne. He remains with the interne until the latter's day's work is finished. He has the privilege of the laboratory and the library. He has assigned to him a piece of literary work to which he gives whatever spare time he has. In this he is assisted by his interne. From time to time he reports progress in the weekly conference of the interne staff which he attends regularly. He pays no tuition and receives no salary and rooms and boards outside the hospital.

Many dozens of students have made use of this opportunity during the past 22 years, and all agree that they have found the system intensely and exceedingly profitable. Most of these students have taken this work during

their summer vacation and many of them have assured me that it is equal in educational value to a semester in the medical school. All agree that the experience doubles the value of their work in the medical school during the following year.

It is clear that this form of hospital teaching, which to my mind is the best possible, does not in any way affect the cost of conducting the hospital. It has this very important effect upon the service in hospitals, namely, that the internes feel the responsibility and are more careful and more acutely interested in their own work because they form the habit of thinking of details.

This plan gives the student an excellent insight into what will be expected of him when he enters the hospital after graduation from medical school.

We have observed a marked superiority of internes who have served in the capacity as externes over those who have entered the hospital without such preliminary service.

It seems worth while to consider the introduction of this service into other hospitals and possibly later to develop a plan which will make it possible for all medical students to have such training before they enter upon the senior year in the medical colleges.

A. J. Ochsner.

PRINCIPLES IN THE TREATMENT OF EMPYEMA

THE aim of all forms of treatment of non-tuberculous empyema is to evacuate the pus, combat sepsis, and restore the structures and functions to as nearly normal as possible, all without undue risk. Difficulties in accomplishing drainage may be due to interference with respiration resulting from a partial collapse of the lungs incident to opening the pleural cavity, or there may be secondary encapsulated pockets. The virulence and metastatic nature of the infective organism may be beyond our powers to combat. In a chronic case structural changes in the lung and in the wall of the chest may be beyond repair.

The data with regard to the treatment of empyema constitute one of the most interesting chapters in the history of medicine. It is a remarkable fact that while the condition was recognized and treated by the ancients, and spasmodically treated throughout the centuries, it is only 60 years since Walter, an American, first excised a segment of normal rib in order to establish drainage.

Although numerous intercostal drainage devices continued to be rediscovered and reintroduced periodically, rib resection came to be the standard operation, with or without one or another of the numerous valve-drainage devices. Most cases were of the frankly purulent type at operation, and the mortality, though on the average high, was considered unavoidably so. Then came the great pandemic of streptococcus pneumonia and empyema. The forbidding mortality resulting from simple rib resection and drainage in these cases and the prompt and great reduction in mortality following the institution of "closed drainage" with irrigation, seemed to indicate that the last word in the treatment of acute empyema after all had not been spoken. Physicians were forced to recognize the danger of pneumothorax in these cases. It was also discovered that it is possible to employ suction rather than gravity for the drainage of pus and that irrigation, particularly with Dakin's solution, was of distinct benefit.

The assumption seems rational that the closed method is indicated in very ill patients with acute empyema of any type, particularly with pulmonary involvement. A to-and-fro suction sound is often heard following open-

ing of the pleural cavity in these cases, indicating a partial collapse of both lungs. In a patient already critically ill this added insult may be the last straw. Air-tight aspiration, on the other hand, tends to increase respiratory capacity by expanding the lung an amount equal in volume to the pus aspirated, which may mean full expansion of the lung from almost complete collapse.

In combating sepsis the most important consideration is the thorough evacuation of the pus. This can be accomplished probably more thoroughly by aspiration and flushing of the cavity with a cleansing solution than by rib resection and gravity drainage alone. The relative superiority of the hypochlorite solution is probably due not only to its germicidal properties, which are considerable when it is used copiously, but also to its characteristic property of separating all necrotic material and pus from the living tissue. Filling the cavity through one air-tight tube, besides being simpler and easier than rib resection followed by an attempt to place a number of Carrel tubes, would seem to insure better contact between the fluid and all parts of the cavity. Such procedure also tends to dissolve the shelving partititions. It is probably important to use large amounts of fluid at frequent intervals during the first days to prevent walling-off of any part of the cavity.

The communication of bronchial fistulæ with empyema cavities may often be proved by injecting methylene blue into the cavity. Dakin's solution, generally speaking, is contra-indicated in the presence of large fistulæ, but normal saline solution may be used.

In a large proportion of cases of chronic non-tuberculous empyema, very material reduction or complete obliteration of the cavities may be secured by irrigation with hypochlorite solution. An extensive plastic operation, besides the hazard it involves, is disabling, as pointed out by Graham, because of the marked reduction it may produce in vital capacity.

CARL A. HEDBLOM.

STASIS AND INFECTION

THE important part that stasis plays in many infectious processes perhaps is not sufficiently realized—in the respiratory passages, in the alimentary, biliary, and genito-urinary tracts, in various excretory and secretory glands, and in other situations.

It is recognized as a matter of course that inflammation is due to micro-organisms, and it is more or less clearly seen that a lack of proper resistance enables the micro-organisms to gain lodgment; but it is not so often perceived that stasis is an important link in the pathological chain.

It may be of interest to group together some observations lending support to this view. Let us consider, for instance, the biliary tract. It is common knowledge that bacteria frequently exist in the bile, and yet infection usually does not appear until stasis occurs, as the result of the presence of a stone, a kink, a stricture, or other causes. One might even venture to explain the frequent coincidence of chronic appendicitis and cholecystitis, by assuming that the former gave rise to a spasm of the sphincter of Oddi, at the outlet of the common bile duct, just as it causes a similar condition at the pylorus, thus leading to stasis and infection in the gall-bladder, for which the appendicitis may furnish the infectious material.

Again, in the digestive tract the effects of stasis are common and striking. For example, Sir Arbuthnot Lane has clearly shown how a "kink" at the lower end of the ileum may back up the contents of the small intestine and produce an ulcer of the duodenum; and every surgeon is aware of the effects of gastric

stasis due to pyloric spasm of appendiceal origin. In fact, one even might go a step farther and speak of the things that may arise before stasis actually occurs; when, although the bowel is still able to overcome an impediment, the consequent muscular and nervous effort causes marked disturbances of the sphincters of the stomach and common bile duct, to say nothing of the bowel itself. Perhaps one could think of this condition as "intestinal strain," just as one speaks of eye strain, in which the individual may be able to see well enough, but the effort to do so gives rise to many disagreeable symptoms. Appendicitis also is very closely associated with stasis, as is abundantly evidenced by the numerous kinks and strictures that accompany it; and many times when such obvious deformities are absent, there is reason to suppose that a difficulty in drainage has arisen from fæcal impaction or from swelling of the mucosa about the mouth of the appendix.

The harmfulness of certain forms of "constipation" are known by everyone, but it is not so universally recognized that the effects probably are due less to the mere fact of fæcal retention than to the growth of bacteria in a stagnant medium, which reaches its maximum effect in acute obstruction.

In the urinary tract micro-organisms, for various reasons, may be present in the urine in great numbers, and yet no inflammation will result unless stagnation occur—from an enlarged prostate, a stricture, or other causes. In fact, patients may be catheterized repeatedly with unclean instruments without harm resulting, unless the bladder is incapable of emptying itself completely, as often occurs following abdominal operations even when there is no actual obstruction. Likewise it is generally conceded that most calculi, especially those associated with infection, are found only in the presence of urinary stasis—in the bladder, in the ureter, or in the pelvis of the kidney.

Attention repeatedly has been called to the tendency of stasis due to narrowing in any portion of the air-passages, from the nose to the bronchioles, to produce chronic tuberculosis and other infections. Many observers also believe that postoperative pulmonary complications often arise from the inhibitory effect of pain on the respiration, resulting in poor ventilation of the lungs, which might be termed respiratory stasis.

Troubles in the accessory sinuses, as is well known to the nose and throat practitioners, are not only frequently caused by poor drainage and stasis, but they do not get well until these conditions are corrected, as is also the case with many abscesses and other forms of inflammation.

Judging from analogy, it is possible that we sometime may learn that certain disturbances of the ductless glands even may be due to the stasis resulting from an inability to get rid of their secretions with sufficient facility.

Hence it may be said that in our physical as well as in our mental processes stagnation is inimical to healthy function. In other words, if the train of our internal activities, so to speak, is kept moving with sufficient rapidity, the bacterial hoboes have no opportunity to get aboard. LEONARD FREEMAN.

CORRESPONDENCE

ACUTE PARTIAL ENTEROCELE IN A POSTOPERATIVE HERNIA

To the Editor: In SURGERY, GYNECOLOGY AND OBSTETRICS for July, 1921, Dr. Charles F. Sawyer, in a paper on "Acute Partial Enterocele in a Postoperative Hernia," says, "I have been unable to find in the literature any case similar to this, viz., an acute partial enterocele in a postoperative hernia." I have recently had such a case and report it.

Mrs. S., housewife, age 45, entered my service at the Methodist Hospital, December 1, 1921, at 4 p.m., with the following history. Five years before she had been operated upon for some pelvic condition. A small hernia had developed at the lower end of the abdominal incision. It was never painful or tender. Four days before admission she was seized with abdominal pains without definite reference to location. The bowels moved and gas was expelled several times.

There was emesis several times but this was never fæcal. On admission there had been no emesis for 36 hours. The bowels had moved the day before. The pulse, temperature, and respiration were normal and the general condition was good. There was no distention but there was general abdominal tenderness, and a small tense mass at the lower angle of the old incision was decidedly tender. The patient was operated on immediately. On the table under anæsthesia the patient vomited a large quantity of fæcal fluid. The stomach was washed out and the operation was begun. The washing was repeated on the table immediately after the operation. The abdomen was opened in the old line of incision above the mass. Exploration showed a mass of omentum and intestine entering a constricting ring at the site of the hernia. The ring was incised by extending the incision downward and the hernia mass exposed. It consisted of adherent omentum and buried in the center of this was a strangulated Richter hernia of the ileum, involving about two-thirds of the lumen.

On releasing the constriction and applying moist heat the hernia showed returning color and was returned to the abdomen and the omentum ligated and removed. The incision was closed and stab drains placed in the pouch under the skin at the lower end of the incision. The patient made a good recovery. One of the great factors in these cases, however, is to see them early, to operate and not do any more surgery than is absolutely necessary. Local anæsthesia is, of course, to be preferred to general anæsthesia in these cases.

JAMES H. BALDWIN, A.B., M.D., F.A.C.S.
Philadelphia.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN SURGERY

SOME four years have elapsed since the appearance of Volume I of Doyen's *Surgical Therapeutics and Operative Technique*.[1] This delay was due partly to the War and then the rather sudden death of the author. Volumes II and III have been at hand for some brief time and it is fitting that this translation should reach the English-speaking profession at the close of so illustrous a life. It stands as a memorial. It is amazing to realize the scope of the activity of one man, so far as surgery is concerned, not only in operative technique which includes every region of the body, but in the almost endless amount of experimental work and clinical study. The author's wide experience and originality is truly indicated by the elaborate descriptions of technique for unusual pathological conditions, as well as for the more or less commonplace.

Volume II includes a continuation of the surgery of the head, operations on the neck, thorax, and the extremities. Many ingenious plastic problems on the face are illustrated. It might be said that the subject of tissue transplantation, such as bone and nerve, and tendon transplantation, is practically omitted. In Volume III the abdominal operations are discussed. The author gives a rather extended discussion of the anatomy and physiology of the stomach. This is very interesting in so much as it is a study of the stomach from an anatomical point of view, and was undoubtedly done before the roentgen-ray came into such common use. The author observed with some variation to our present opinion, the position of the stomach in its various states of activity. The discussion of the pylorus in pylorospasm is truly interesting, even though one may not accept everything that is said. In regard to carcinoma, it is only fair to the author to state that during the last few years of his life his position regarding the microbic cause of cancer was not so strong and it became again a question in his mind as to the causation of cancer. In the discussion of carcinoma, he makes some rather unusual statements, not only in regard to the etiology but to the treatment. These may be summed up in a few statements. That the cause of carcinoma is the micrococcus neoformans, that a serodiagnosis analogous to the Wassermann reaction can be made. He even goes so far as to give the detailed technique for the reaction. He advocates against surgical procedure in deep-seated carcinoma, stating: "Surgery alone is powerless to give durable results in cancer of the stomach. But antineoplastic vaccination using injections of mycolysine combined with the toxins of the cell bodies of the micrococcus neoformans killed by means of heat, called cytolase, has had numerous successes in my hands during the past 10 years." One cannot help speculating why a surgeon with such technical skill and with such a keen surgical judgment should come to such conclusions. Doyen's experience with carcinoma should be a lesson to many present-day students of carcinoma who are beginning to believe they have found the cause of cancer.

The chapter on vaginal operations is intensely interesting as the author was surely a master of this phase of surgery and was the originator of many vaginal operations and many he modified to meet his demands to make toward simplicity.

Both volumes are profusely illustrated, the cuts being very clear and extremely well done.

One cannot lay these two volumes aside without expressing a great admiration for the skill, the untiring industry, and courage, notably the stand taken in carcinoma for the great pioneer in surgery.

J. A. WOLFER.

INTERNATIONAL visiting by "Yankees" in South American countries has been traditionally and almost invariably promoted by interests of commerce or politics. There were, therefore, refreshingly new auspices for both guests and hosts in the two purely socio-professional visits of Dr. Franklin H. Martin and his companions to the countries of South America in 1920 and 1921. The visits were instituted by the American College of Surgeons to establish a permanent, enlarging intercourse between the surgeons of North America and South America.

The present writer recalls no other single work on South America that exhibits so sympathetically the obliteration of the traditional *impasse* between North and South Americans, the instant establishment and maintenance of a cordial and understanding rapprochement between representatives of the two continents as does *South America*.[2] The collaborators, Dr. Martin, Dr. William J. Mayo,

[1] SURGICAL THERAPEUTICS AND OPERATIVE TECHNIQUE. By E. Doyen. English edition prepared by the author in collaboration with H. Spencer Browne, M.B.(Cantab.). New York: William Wood & Co.

[2] South America from a Surgeon's Point of View. By Franklin H. Martin, C.M.G., M.D., F.A.C.S., in collaboration with William J. Mayo, M.D." Thomas J. Watkins, M.D., and Francis P. Corrigan, M.D. New York and Chicago: Fleming H. Revell Company, 1922.

Dr. Thomas J. Watkins, and Dr. Francis P. Corrigan, have brought back to North Americans a wholesome and compelling admiration for South American countries and peoples. What is more to the point, they have expressed this admiration by compiling a most convenient hand book to "aid and abet" others—especially those of the medical profession—to follow the line of their pilgrimage.

The work is remarkably well done. It is astonishing with what happiness and simplicity the gigantic Andean scenery, the outstanding national figures, the great histories and accomplishments of such versatile peoples, and withal the lure and beauty that are so distinctly South American, have been compressed into two hundred and twenty-nine pages, multitudinously illustrated.

The charm of the Latin peoples and the delights and strangeness of semi-tropical picturesqueness show on every page of type and photograph.

The second section of the book gives a most useful summary of all the important facts—commercial, governmental, historical, geographical, and utilitarian—concerning the countries visited. The third section of the book provides what is under utilitarian criticism, a very helpful vocabulary for the use of the South American tourist. Very happily, sufficient prominence is given to Portuguese, as well as Spanish. To the epicure, the number of words and phrases "for use in a restaurant" is most appealing.

If anything were needed to clinch a 1923 visit of an extremely large delegation of Fellows of the College to South America, it would be this appealing work of the Director General and his companions, which is really an informal report to the Fellows of North America on the personnel and activities of their confrères in the South American continent. R. I. R.

NO part of the body has received so careful an anatomical study, so far as it relates to infection, as the hand, and yet, I believe I am correct in stating more surgeons know how to remove an appendix or drain a gall bladder correctly than know how to treat properly an infected hand. Considering the frequency of infection of the hand and the disastrous results from improper treatment, this discrepancy becomes a tremendous factor at the present time. If many surgeons do not know how to treat infected hands what can be expected from the practitioner into whose hands many of these cases fall, at least early when the infection is in its incipiency and when proper treatment means prompt cure—with complete restoration of function and satisfactory cosmetic conditions. The re-edition of Kanavel's work,[1] although there are few changes or additions, comes again as a masterpiece. Due to the author's extensive and painstaking study of the hand and forearm, he has made the subject of infections of the hand and forearm comparatively simple.

To those who are familiar with the work, little need to be said. It is the accepted authority, and all are pleased to see a re-edition with additions, such as deal with infections in general, especially gas bacillus infection and reconstruction. For those who are unfamiliar with the treatise, not only is there much absolutely necessary information at hand for them, but the plan laid down by Dr. Kanavel is absolutely essential, for the proper treatment for infection of the hand. There are no more striking and marvelous results obtained in the treatment of any surgical condition than are obtained in tendon sheath and fascial space infection. The diagnosis can be made with comparative security; the results are little less than spectacular. From the reviewer's experience, having had at one time the great pleasure and profit of an assistantship with the author, the information set forth in the volume is absolutely necessary for the scientific treatment of infections of the hand and forearm. Unless these conditions are diagnosed properly and the correct treatment applied, the results are far from satisfactory, in many instances disastrous, not only as to function of the hand, but at times complete loss of the essential part with not infrequently loss of life.

It is an accepted fact that any physician who finds it necessary to treat infections of the hand must acquaint himself with the fundamental anatomical and surgical facts, which are peculiar to the hand, and unless he does so, he is not giving his patient the treatment which is demanded. J. A. WOLFER.

IN more or less contrast with the aforementioned work appears a new work by Horsley.[2] Here we have operative surgery approached in a new and novel manner, a manner which must of necessity appeal to any surgeon. It seems to the reviewer that most texts in the past have approached this problem in a rather harsh and even brutal manner on a more or less strictly anatomical basis. Now we have a man who has the courage to put physiological and biological function before strict anatomical considerations. As the author states the extirpation or correction of the pathology is of prime importance, yet physiological and biological principles should not be sacrificed unless absolutely necessary.

This work instead of being of the ordinary stereotype form approaches general principles first. The discussion of surgical drainage is very interesting and instructive.

Surgery of blood vessels, nerves, bones, plastic surgery, and the like are discussed from a general standpoint, emphasis being laid on biological and physiological principles,—then operations are described which the author has found most satisfactory and which in his mind, even though not used, seem to be indicated. This is not a compend of operative technique, and in every instance the operative

[1] INFECTIONS OF THE HAND, A GUIDE TO THE SURGICAL TREATMENT OF ACUTE AND CHRONIC SUPPURATIVE PROCESSES IN THE FINGERS, HAND AND FOREARM. By Allen B. Kanavel, M.D. Philadelphia and New York: Lea & Febiger, 1921. 4th ed.

[2] OPERATIVE SURGERY. By J. Shelton Horsley, M.D., F.A.C.S. St. Louis: C. V. Mosby Company, 1921.

technique described bears more or less the mental imprint of the author.

The subject of reversal of the circulation is described and found by the author not yielding the desired results. The various regions of the body are covered but the operative procedures advised and described are based entirely to correct or remove pathological conditions rather than simply to describe a variety of operations. In every case the subject is approached by a general discussion of the physiology and pathology of the part in question, always keeping function in mind. In no chapter is this better illustrated than in that devoted to operation on bone.

The text is interestingly written. The type is clear and placed on excellent paper. The illustrations are many and extremely well done and really illustrate a point rather than being simply a beautiful picture. Above everything else, however, this work incorporates one man's acceptances so far as surgical technique is concerned; it is not the soulless tabulation of every surgical procedure known to the surgical profession. J. A. WOLFER.

DUE to the rapid strides of modern civilization, carrying with it undue and numerous penalties, the general practitioner is very often called upon to give emergency treatment to a variety of conditions under most unfavorable and trying circumstances. This ever-increasing demand on the average physician has no doubt brought about not only the first edition but the rewriting of Moorhead's *Traumatic Surgery*.[1] Here we have incorporated in one volume practically all the essential data for the care of traumatic conditions, given in a simple, unassuming, and concise manner. The author makes no pretense to offer an exhaustive treatise on fractures, burns, infections, etc., but states very briefly what he has found a satisfactory form of treatment.

The second edition shows considerable change from the first, yet withal the book remains practically the same in intent. Those surgical measures which were more or less proved by military surgeons are incorporated in the volume. This includes chiefly wounds, compound fractures, joint injuries, and functional re-education.

The active and experienced surgeon will find very little that is new in this volume, but it will be a boon companion to the inexperienced surgeon or to the practitioner who must of necessity meet surgical emergencies of traumatic nature. J. A. WOLFER.

ONCE again we have before us a new treatise on *The Principles and Practice of Surgery*.[2] This work, which may be obtained in one or two volumes, supplies a certain want. It is probably best suited for the student in college—for collateral reading—and for the general practitioner who wants a ready and available work for reference and who has not the time nor inclination to read extensive and detailed monographs. It does not appear to the reviewer that such a work could be accepted for didactic teaching, as the amount of material given could only in rare instances be appreciated or assimilated by the student who studies surgery for the first time. No doubt the treatise was read by the reviewer with a spirit of skepticism, due to the fact that there are no less than a dozen treatises on the same subject before the profession, and one cannot help but wonder why another. It would appear to the casual observer that there should be some logical reason for producing such a work at this time. The author must be either a great technician, a great surgical teacher, or a man possessed with great diagnostic ability, and for this reason his medical associates and students may rightfully demand from him something in a literary way, which they can possess and can have with them more or less at all times. This seems to be the case with the present treatise. It is not necessarily written to fill any distinct want exclusive of what has been expressed, but it seems to be the final effort of a teacher and a surgeon.

The material incorporated in this work is enormous and the effort to produce it must have been gigantic. One is impressed with the almost exclusive reference to German literature and for that reason places new and some neglected and probably forgotten names and ideas before the reader which withal should not detract from the work; on the contrary, it serves well to round out the widest conception of surgery.

The greater part of the work is devoted to a description of general surgical principles. The subject matter is very interestingly handled and the general plan is good—probably different from any similar work. The endeavor to carry the reader along a line of surgical conception from the simplest to the more complicated is well accomplished.

On the regional surgery, that dealing with the brain deserves distinct notice. This interesting and difficult phase of surgery is discussed in a thorough and efficient manner.

This treatise covers some 2,400 pages. The type is clear. Important phrases are put in italics. The wide spacing makes easy reading. Withal there are many commendable features to the treatise which makes it a valuable addition to the average medical man's library. J. A. WOLFER.

PROBABLY no region of the body affords more interesting or complicated pathology than the upper abdomen. The close proximity of the liver, gall bladder and ducts, stomach and pancreas to one another, and the variety of pathological conditions which may effect or be peculiar to each, surely makes this region the menagerie of pathology in the human body. To be conversant with one organ and its pathology means that all the surrounding organs must receive almost an equal amount of attention and study. It is thus with much interest and pleas-

[1] TRAUMATIC SURGERY. By John J. Moorhead, B.S., M.D., F.A.C.S. 2 ed. Philadelphia and London: W. B. Saunders Company, 1921.

[2] THE PRINCIPLES AND PRACTICE OF SURGERY. By Herman A. Haubold M.D. New York: D. Appleton & Co., 1921.

ure that the second edition of the *Surgery of the Upper Abdomen* by Deaver and Ashhurst [1] is reviewed. The first edition appeared in two volumes, published several years apart. The present re-edition is in one volume without sacrifice of text, and has the added attraction of more material and illustrations, with the ever-growing statistics, especially of the senior author's service summarized and brought to date.

Part I is devoted to the surgery of the stomach and duodenum. Here every possible pathological condition of these organs is discussed in detail with many interesting statistics, not only from the authors' service but from the large clinics of the world at large. The technique for the various operations is also included. Such rare conditions as syphilis, tuberculosis, benign tumors, and phlegmonous inflammation of the stomach are taken up. Part II incorporates the surgery of the gall-bladder, liver, pancreas, and spleen. Here again is a fertile field for study. The chapters on the pancreas are especially interesting and instructive.

This volume gives an enormous amount of information which is most desirable to the experienced as well as the inexperienced surgeon. The many instructive illustrations, nearly one hundred being new, add much to the attractiveness of the work. The text is written in a clear and unmistakable tenor, and leaves little unsaid, so far as our present-day knowledge of surgical diseases of the upper abdomen is concerned. J. A. WOLFER.

THIS excellent monograph on tuberculosis of the bones and joints by Dr. Eugen Kisch[2] is profusely illustrated with photographs, diagrams, drawings, and roentgenograms. The purpose of the book is to show that by the combination of sunlight, passive hyperæmia, and iodine therapy even extreme cases can be cured in as short a time in the low lands as in the mountains of Switzerland. He contrasts the diametrically opposed methods of treatment in use today, namely, absolute immobilization and no surgery, and surgery. He agrees that the first methods will result in cure but with ankylosis and that the Bier method effects a cure with a movable joint. He advises against surgery because at best it can remove only macroscopic disease and carries with it the danger of spreading the infection.

The chapter on heliotherapy and the various lamps used is complete. A skin thermometer is described. The importance of pigmentation of the skin is emphasized. The technique of the treatment of tuberculous abscess is well illustrated. In the chapter on tuberculous disease of the vertebræ excellent pathological specimens are shown. Very good roentgenograms are included and an illustration of a recumbent apparatus for fixation and a very good special brace without an apron. (This is used instead of the American spinal assistant of Taylor.)

The chapter on disease of the knee contains an excellent roentgenogram of a Charcot joint illustrating the absence of atrophy, so characteristic of that disease. An excellent recumbent apparatus for the correction of backward luxation of the tibia is described. PHILIP LEWIN.

THESE two very readable volumes by Calot [3] were written for the general practitioner primarily but are of infinite value to the orthopedic surgeon. The work is profusely illustrated with excellent cuts, most of which were made from illustrations by Dr. Fouchou-Lapeyrade, assistant to Dr. Calot.

In discussing the treatment of bone and joint tuberculosis, Calot enumerates six points: (1) he avoids cutting, (2) he punctures and injects, (3) he employs rest and complete immobilization by means of plaster-of-Paris apparatus, (4) he avoids violent measures in making corrections, (5) he advocates having patient live continually in the open air, and (6) he advises overfeeding under supervision.

He believes that the value of heliotherapy has been exaggerated but that it should be used as an adjuvant (one of the numerous auxiliaries) in the treatment of external tuberculosis. Considerable space has been given to the discussion of tuberculosis of the skin, glands, and genito-urinary tract—subjects which are not considered orthopedic.

He describes in great detail plaster-of-Paris technique and shows many beautiful illustrations of celluloid apparatus. Much stress is placed upon modelling the cast over the iliac crests and knees, for one cannot completely immobilize a knee unless the hip and ankle are included in the cast. The chapter on scoliosis is short and the work of Abbott, which was included in the former edition, has been omitted. He described a special lever sole which he finds of distinct value in treating flat foot or tarsalgia. Only brief space is allotted infantile paralysis, and congenital dislocation of the hip is discussed only from the author's point of view. Adolescent coxa vara he ascribes to rickets. No mention is made of the endocrine glands.

The technique used in subcutaneous tenotomy of all the important tendons including the Achilles, hamstrings, sternocleidomastoids and adductors of the thigh (the latter being regarded among some orthopedic surgeons as entailing considerable risk) is given. He illustrates very well the technique of puncture into the hip, knee, ankle, shoulder, elbow, and wrist joints. The technique of puncturing an abscess in the iliac fossa without incision through the abdominal wall is described. (This is a very hazardous procedure even for the specialist and

[1] SURGERY OF THE UPPER ABDOMEN. By John B. Deaver, M.D., Sc.D., LL.D., F.A.C.S., and Astley Paston Cooper Ashhurst, A.B., M.D., F.A.C.S. 2d ed. Philadelphia: P. Blakiston's Son & Co., 1921.

[2] DIAGNOSTIK UND THERAPIE DER KNOCHEN- UND GELENKTUBERKULOSE MIT BESONDERER BERUECKSICHTIGUNG DER THEORIE UND PRAXIS DER SONNENBEHANDLUNG. By Dr med Eugen Kisch Leipzig: F. C. W. Vogel, 1921.

[3] INDISPENSABLE ORTHOPEDICS; A HANDBOOK OF TREATMENT. By F. Calot. 2d English edition, translated from the 7th French edition by A. H. Robinson, M.D., M.R.C.S. 2 vols. St. Louis: C. V. Mosby Co., 1921.

should not be attempted by the general practitioner. I have seen Calot perform this operation very successfully and with apparent ease.)

Complete formulæ and directions for the preparation of Calot's several solutions, pastes, and powders are given. The author's orthopedic table is shown. Calot places much emphasis on the apparent preliminary lengthening of the affected leg in tuberculosis of the hip-joint. His fundamental dogma in the treatment of external tuberculosis is: "Never open, nor allow to open, a tuberculous focus." There is a noticeable omission of discussion of such subjects as birth palsy, spina bifida, congenital scoliosis, congenital defects of long bones, Sprengel's deformity, etc.

A word of commendation should be said for the excellent translation of Dr. A. H. Robinson.

PHILIP LEWIN.

THE third edition of *The Practice of Urology*, by Chetwood, is a very well written book. The chronological order of subjects makes it a pleasure to read. The material is thoroughly treated without being too voluble so that it should prove to be valuable as a text for the student as well as for the practitioner. The author has emphasized the important parts throughout by the use of heavy type. This outlines the book and improves it as a text. Anything new that pertains to urology which has proven to be sound in principle and application has been included. The chapter on cystoscopy is very thoroughly and well written. At a time when so many are making the cystoscope an invaluable addition to their diagnostic armamentarium this section should prove not only interesting but very instructive. A complete cystoscopic unit is described in detail.

If there be a weak part in the work, it is in the discussion of the embryology and anatomy of the genito-urinary system, but these parts cannot be covered quite so thoroughly in a work of this sort as they are in texts on anatomy and embryology.

The indications for operation, pre-operative treatment, technique, and postoperative care are thoroughly discussed; for example, the management of prostatics. Roentgenography, as it pertains to urology, is discussed under lesions of the kidney, ureter, bladder, and prostate.

We shall not enter into the discussion as to whether or not a text on urology should consider venereal diseases as they involve the entire system or only as they may pertain to the genito-urinary organs. But it is obvious that if one would have a lucid conception of syphilis and its treatment as it applies to the genito-urinary tract, the subject in all its phases should be clearly understood. The chapter on syphilis has been covered most clearly and for the student, at least, should prove most valuable. The illustrations throughout the book are excellent and well chosen. The entire monograph is logically, smoothly, and thoroughly handled, and can be recommended to student or practitioner alike.

W. H. WOOLSTON.

MARION'S *Traité d'urologie*[2] represents the present trend of urology in France. The French have been pre-eminent in the development and advancement of urologic surgery from the time of Guyon and Albarran. Marion has followed in the footsteps of a long line of urologists who have stored up in the Musée Civiale a wealth of available pathological material. The author has been one of the editors-in-chief of the French *Journal d'Urologie* since its inception in 1912 and has had a wide personal experience; he is particularly well fitted to write a textbook on urology. His book, however, deals largely with urologic surgery, and a good description is given of French methods, experiences, and results.

In volume I the anatomy of the genito-urinary tract is discussed; the various methods of examination, manipulation, and exploration are then taken up. There are chapters on cystoscopy, ureteral catheterization, and radiography, with a description of the different types of apparatus and the methods employed in the various laboratory examinations. The chapters on urography and renal functional tests, however, are inadequate and do not contain the more recent developments in these subjects. It is surprising to note that the metal searcher is still used in the detection of vesical calculi.

There is a very good chapter on infections of the kidney. Renal tuberculosis in its various phases is discussed fully; the various types, pelvic, caseous, and pyonephritic, are described and excellently illustrated. The types of renal tumors are considered from the standpoint of their clinical detection, pathology, and treatment; the gross and histological pathology is clearly illustrated. Other anomalous and pathological conditions of the kidneys and ureters, infections, calculous and cystic formations, are described and illustrated by photographs of unusually well-preserved specimens.

Chapters are given to affections of the bladder, traumatization, infectious tumors, and calculi. The short description of tumors is illustrated by a number of unusually clear etchings.

Volume II deals with affections of the penis, prostate, and bladder. In a complete chapter on the urethra a review is given of the course and treatment of the various types of urethritis with complicating conditions, stricture, prostatitis and vesiculitis. The tumors of the urethra are discussed briefly, with an indication of the location, frequency, and various histological types. The pathological anatomy, clinical course, and treatment of prostatic diseases, tuberculosis, hypertrophy, and malignancy are covered in detail.

[1] THE PRACTICE OF UROLOGY; A SURGICAL TREATISE ON GENITO-URINARY DISEASE INCLUDING SYPHILIS. By Charles H. Chetwood, M.D., LL.D., F.A.C.S. 3d ed. New York: William Wood & Co., 1921.

Traite d'urologie. By G. Marion. Paris: Massons et Cie, 1921.

Another chapter details the technique of a number of specialized operations on the kidney, some of which are seldom practiced by urologists in this country, such as nephropexy, ureteropelvic anastomosis, and renal decortication. Operations for vesical tumors and diverticula are outlined and the various operative steps clearly illustrated.

The common urethral and endovesical manipulations and the instruments employed are described. A number of operative procedures, infrequently employed by American surgeons, are outlined, such as the direct method of ureterovesical anastomosis, the ureter being put through the bladder at a right angle. No mention is made of the valve-establishing types of operation on the ureter in common use in this country. Internal urethrotomy and suprapubic puncture of the bladder are still employed by the author. The perineal method of prostatectomy for cancer is fully described and is evidently recommended. The use of radium for cancer of the prostate is scarcely mentioned. The chapter on therapeutic agents recommended for lesions in the urinary tract would hardly be endorsed by American colleagues. A number of proprietary preparations, such as Harlem oil, uroseptine and piperazin are recommended.

The absence of collateral literature and references to the experiences of other observers is a regrettable feature. There are but few actual contributions to our previous knowledge concerning most of the subjects treated. The portions dealing with the clinical considerations of some of the lesions are somewhat inadequate. On the whole, however, the treatise may be recommended as an excellent review of our knowledge of the various surgical diseases involving the urinary tract and particularly their surgical treatment.

W. F. Braasch.

AMERICAN COLLEGE OF SURGEONS

THE JOHN B. MURPHY MEMORIAL

THE plans and activities of the John B. Murphy Memorial Association, and of the Fellows of the American College of Surgeons working in co-ordination, have rapidly brought about the certainty that the next few months will see the completion of the necessary fund and adoption of plans for the building itself.

On the opposite page is shown in colors a suggested plan of the memorial building submitted by a prominent architect of this city. What has previously been said by the laity and surgeons concerning the type of building desired is evidently very effectively worked out in this proposed plan. The location of the memorial beside the present home of the College, and the use in the more remote future of the adjacent property for the third building of the College, are points shown in the illustration on the following page. This gives a sketch of the College domicile as it is to be developed. In contemplating these two illustrations, one feels that America will have as much right to pride in the home of its surgical guild as have the British in the impressive buildings of the Royal College of Surgeons in Lincoln's Inn Fields, London.

All too frequently memorials to men of outstanding ability have stood as useless effigies, decorative tablets, or empty unfrequented halls—the very type of memorials that would be most earnestly deprecated by the great workers in whose memory they have been established. In planning and executing the John B. Murphy Memorial, precisely the opposite point of view is held by all concerned. While the dignity, beauty, and civic effectiveness of the building will be all that its donors could desire, its working usefulness will be to them and to the public, who will know the story of what it houses, a constant source of satisfaction that they have had the privilege of contributing to its erection.

Primarily, the memorial in its plan and appointments will be the type of structure that the great surgeon himself would approve. Secondly, it will be the atrium of the home of the American College of Surgeons, the international association of the western hemisphere and the center whence surgical research and influence will be inspired for the profession in North and South America.

The memorial, will at once lodge the library of the College with a staff of trained librarians and research workers. This repository forms the nucleus of what will some day become a comprehensive literary research library. Already additional volumes, monographs, and journals are arriving so rapidly as to make even their unpacking a serious problem, to say nothing of a space in which to house them.

The Literary Research Department of the College is engaged in the extremely important work of furnishing to inquiring physicians and surgeons throughout the country the most complete available information gathered from the local libraries and from the Surgeon General's Library in Washington, on any and all cases and phases of medical and surgical work. This information is furnished at cost. As is evident, this service is of the highest value to the inquiring physician, with his specific and frequently abstruse or novel problem. The high efficiency with which these researches are being carried out, and the wealth of library research entailed, are best known to those who have availed themselves of this department's services.

Eventually, the home of the American College of Surgeons will consist of the central monumental structure, the John B. Murphy Memorial, devoted to a memorial hall, museum, and library, and the present magnificent building devoted to the administrative activities of the College. It will be the policy of the College to refrain from accepting additional building responsibilities, until funds are in sight for their construction and an endowment in addition that will provide an income equal to the task of an abundant maintenance.

The completed building will contain the administration workrooms of the College; a large hall for the stated convocations of the College and important national gatherings; reading-rooms for visitors; a pantheon of American surgery in its corridors and halls where the memory of surgeons of the past will be honored by bronzes, busts, and portraits. It will become the home of

Proposed design of the Dr. John B. Murphy Memorial Building.

American surgery and the rendezvous to which many hundreds of medical men will be called by duty each year.

The American College of Surgeons, to carry out its large program, will touch in its influence many phases of our national life. In its work to improve the kind of surgery done by the average surgeon it must deal in a fundamental way with the standardization of hospitals, the training of nurses, and with the larger work of medical teaching, which will bring its influence to bear on medical schools, universities, and the preparatory schools. There must be committees on credentials and on examinations. This work must radiate from a large working force in a central home. The Memorial will provide a homecoming place for the hundreds of Fellows and prospective Fellows who must inevitably visit headquarters each year.

The Fellows of the College are already taking rapid advantage of the privilege to assist in the erection of their own home. It is evident that the next few months will see the completion of that part of the fund allotted to the American College of Surgeons.

The Citizens' Committee, under the effective chairmanship of Mr. Edward Hines, is carrying out its part of the project with equal rapidity. It is practically certain that fall will see the commencement of work on the John B. Murphy Memorial.

Public-spirited citizens and Fellows of the College in Chicago have already given the present magnificent home of the College and the site for the building of the Murphy Memorial. Through the munificence of the late Mrs. Murphy and the activities of the most far-sighted of Chicago's prominent men of affairs, three-fifths of the entire cost of the memorial will have been raised in a short time.

The obligation on the Fellows of the College is only two-fifths of the entire cost of the memorial. The activity of the Fellows in fulfilling their share of the memorial cost is exceedingly gratifying at the present time. When it is realized that by their contribution of $200,000, the Fellows and the College will come into enjoyment of this splendid $500,000 edifice, it would seem inevitable that the rest of the apportionment of the Fellows should be raised in a very brief time.

THE NEW AND GROWING COLLEGE LIBRARY AND ITS FAR-REACHING FIELD OF SERVICE

"You are building what will doubtless prove to be the standard surgical library of the world." This enthusiastic endorsement was given the College Library by an English surgeon when the new plans were presented to him.

A scientific organization of the size and permanency of the American College of Surgeons must necessarily have a library which will preserve the works of its members and the records of its research. The College has asked that each Fellow contribute autographed copies of books and reprints of articles written by him; and these contributions, which are now rapidly accumulating, will go far in making this library representative of the best in American surgery.

With these contributions and the valuable Murphy collection as a nucleus, it is the purpose of the College to make this library a most complete and monumental collection of surgical literature in which will be preserved the record of the development of surgery on the American continents.

The College greatly desires all works of historical interest. Each Fellow has also been requested to send in a list of the books and journals, bound and unbound, which he is willing to donate or loan to the College Library from his private collection. The hearty response of the Fellows and the co-operation of the medical profession in this country and abroad affords the best endorsement of the library and assurance of its success. Over a hundred medical journals and year books have the College on their complimentary mailing list, other medical libraries have placed their duplicate files at the disposal of the College, and the same substantial co-operation has even been extended from libraries across the water.

Thus the collection grows until the most pressing need at the present time is for shelf space and means of making the library immediately available for surgical research work.

It must be a reference library in the truest sense of the word, equipped with every research facility and seminar rooms where the Fellows may come to do their work. The new building is an immediate and vital necessity so far as the library is concerned. Stack space is needed and, to plan wisely, future capacity must be estimated at 125,000 to 150,000 volumes. A general reading room, periodical room, and individual research rooms must be included in the plans for new library space.

For the surgeon who cannot come to the library, there will be duplicate journal files, books, and pamphlets which may be loaned to him upon request.

The library must develop in such a way that it will be just as useful to the men in the far West, the East, and the South as to the men of the Middle West,—just as useful to the men in Canada and South America as to the members in the United States.

This is the aim and immediate concern of the Department of Literary Research of the College. The full purpose and the present work of this Department will be the subject of a subsequent article. That the Department is filling a real need is shown by the daily requests from surgeons for bibliographies, abstracts, and translations to aid in their literary work. During the development of the College Library, the Department has the use of the John Crerar Library, one of the most complete medical collections in the country, and whenever necessary calls upon the Surgeon-General's Library.

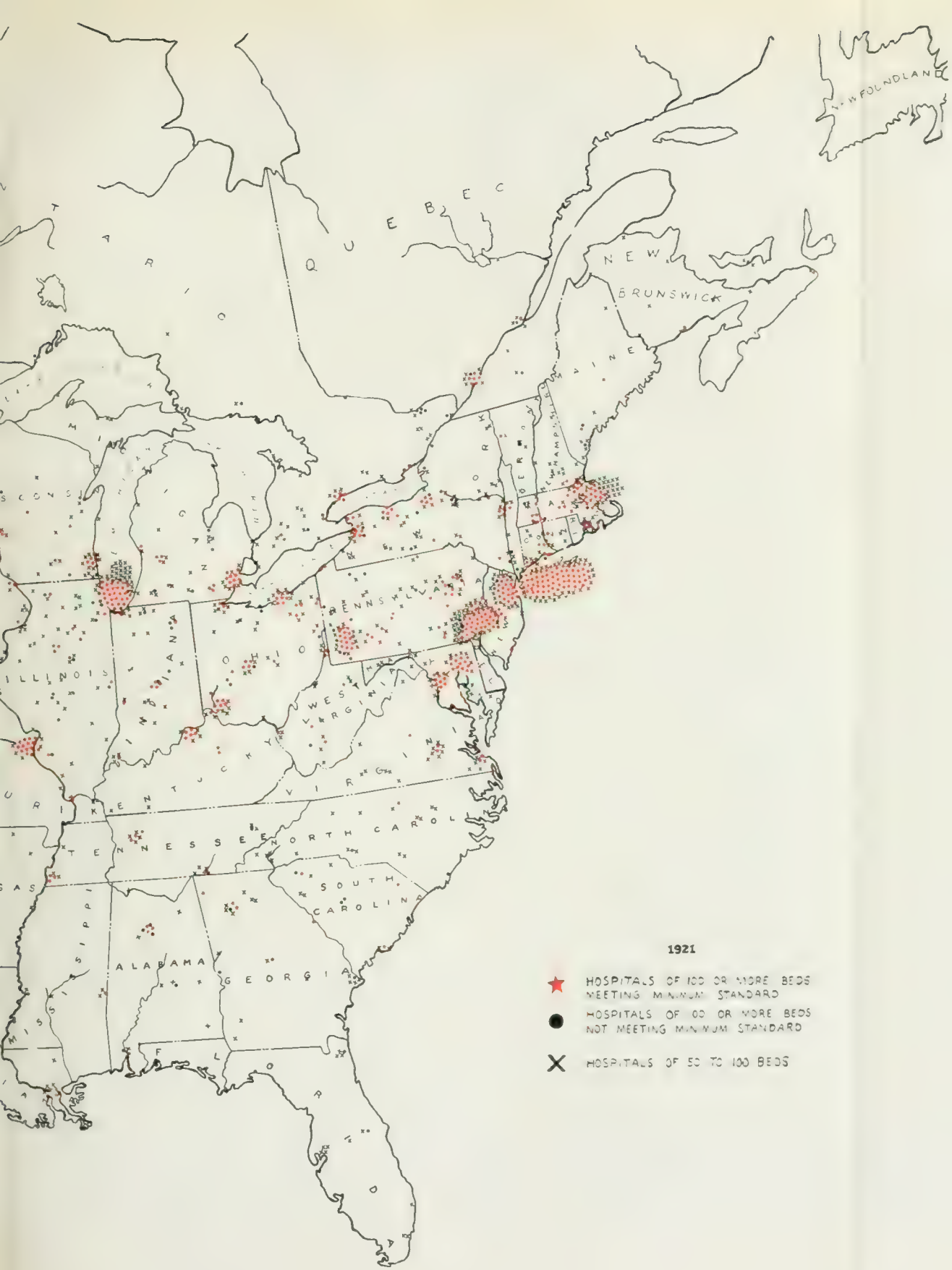
From this brief description it is plainly seen that in *scope*, *purpose*, and *service rendered* this library is in no sense a duplication of any existing library, that it will render a unique and important service to the surgical profession in America, and that it is worthy of immediate co-operation, adequate equipment, and housing.

PROGRESS OF HOSPITAL STANDARDIZATION IN 1920 AND 1921

PERCENTAGE OF 100-BED GENERAL HOSPITALS MEETING MINIMUM STANDARD

UNITED STATES	1920			1921		
	Number of Hospitals	Approved		Number of Hospitals	Approved	
		Number	Percentage		Number	Percentage
Alabama	9	3	33.3	9	4	44.4
Arizona	1	0	0	1	0	0
Arkansas	5	3	60	6	3	50
California	34	15	44.1	42	28	66.6
Colorado	13	3	23	12	7	58.3
Connecticut	12	8	66.6	13	11	84.6
Delaware	1	0	0	1	1	100
District of Columbia	10	4	40	10	9	90
Florida	5	0	0	3	0	0
Georgia	7	2	28.6	8	4	50
Idaho	1	1	100	1	1	100
Illinois	55	22	40	61	36	59
Indiana	17	9	53	16	10	62.5
Iowa	9	6	66.6	13	12	92.3
Kansas	4	2	50	5	3	60
Kentucky	8	7	87.5	8	8	100
Louisiana	7	7	100	7	5	71.4
Maine	5	1	20	5	2	40
Maryland	12	9	75	14	13	92.9
Massachusetts	32	18	56.2	38	32	84.2
Michigan	19	14	73.6	21	17	81
Minnesota	21	16	76.2	21	19	90.5
Mississippi	3	1	33.3	3	1	33.3
Missouri	21	16	76.2	21	18	85.7
Montana	5	3	60	5	5	100
Nebraska	7	5	71.4	8	7	87.5
New Hampshire	1	0	0	1	1	100
New Jersey	30	19	63.3	31	25	80.6
New York	95	59	62.1	104	87	83.6
North Carolina	3	1	33.3	3	1	33.3
North Dakota	4	2	50	5	5	100
Ohio	35	25	71.4	35	29	82.8
Oklahoma	2	2	100	2	2	100
Oregon	3	1	33.3	3	3	100
Pennsylvania	71	48	67.6	80	66	82.5
Rhode Island	3	1	33.3	3	2	66.6
South Carolina	6	3	50	6	3	50
South Dakota	1	1	100	3	2	66.6
Tennessee	8	4	50	8	7	87.5
Texas	14	11	78.6	17	12	70.6
Utah	4	2	50	5	3	60
Vermont	1	1	100	1	1	100
Virginia	5	4	80	5	5	100
Washington	12	7	58.3	16	12	75
West Virginia	7	5	71.4	7	6	85.7
Wisconsin	19	13	68.4	19	14	73.6
Wyoming	1	1	100	0	0	0
Totals for United States	644	385	59.9	706	542	76.9
CANADA—Alberta	5	2	40	5	5	100
British Columbia	6	5	83.3	6	6	100
Manitoba	8	3	37.5	8	4	50
New Brunswick	1	0	0	1	1	100
Nova Scotia	1	1	100	2	2	100
Ontario	19	3	15.7	22	8	36.3
Quebec	9	6	66.6	10	7	70
Saskatchewan	4	2	50	4	4	100
Totals for Canada	53	22	41.5	58	37	63.8
Grand totals for United States and Canada	697	407	58.4	764	579	75.8

COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
WASHINGTON
IDAHO
MONTANA
NORTH DAKOTA
MINNESOTA
OREGON
SOUTH DAKOTA
WYOMING
NEBRASKA
IOWA
CALIFORNIA
NEVADA
UTAH
COLORADO
KANSAS
OKLAHOMA
ARIZONA
NEW MEXICO
TEXAS


QUEBEC
NEW BRUNSWICK
MAINE
NEWFOUNDLAND
ILLINOIS
INDIANA
OHIO
KENTUCKY
TENNESSEE
ALABAMA
GEORGIA
SOUTH CAROLINA
1921
HOSPITALS OF 100 OR MORE BEDS MEETING MINIMUM STANDARD
HOSPITALS OF 00 OR MORE BEDS NOT MEETING MINIMUM STANDARD
HOSPITALS OF 50 TO 100 BEDS

MEETING IN ST. PAUL OF THE MINNESOTA, WISCONSIN, NORTH DAKOTA, AND MONTANA STATE SECTIONS OF THE AMERICAN COLLEGE OF SURGEONS

ST. Paul was the locus January 9 and 10 for the annual group meeting of the American College of Surgeons for the States of Minnesota, Montana, North Dakota, and Wisconsin—held in conjunction with the clinic week of the Ramsey County Medical Association. This is the first meeting of the College in conjunction with a conference of local state or county bodies; and the interest displayed by the members of the medical profession drawn together by the Ramsey County meeting appears to indicate that this new step is altogether a wise and proper one.

Arrangements were made through Dr. Thomas McDavitt, chairman of the local Executive Committee for the College to check the attendance of Fellows from the general registrations at the Ramsey County meeting. There were 70 Fellows present.

The Credentials Committee of the College for the State of Minnesota met Sunday night January 8. The Committee for Wisconsin met Monday forenoon, and the Committees for Montana and North Dakota on Tuesday morning. The Committee members evinced a thorough sense of the responsibilities intrusted to them, and their deliberations were carried on with every evidence of careful and fairest judgment. It should be noted here that the primary function of Credentials Committee members is to furnish themselves with complete data regarding the fulfillment by candidates of certain requirements for admission to Fellowship in the College. These requirements are very definite, and it would expedite the work of the Credentials Committee if its members would convince themselves thoroughly of the adequacy of their information on every candidate some time in advance of the meeting. Such lack of information was evident in but few cases. It would be well to have it eliminated entirely.

The local press was very solicitous for publicity of all kinds, not only concerning the work, scope, and organization of the College, the hospital standardization campaign, and so forth, but with regard to the speakers themselves. And while the publicity was of considerable assistance to the general public, as well as to the arriving members of the medical fraternity, in locating the meetings and identifying the speakers, it caused some little embarrassment to the staff and speakers alike. While the inevitable camera-man was successfully evaded, the surreptitious cartoonist was in evidence.

Monday carried the heavy program of the College, inasmuch as both the meeting on hospital standardization and the public gathering on the definite phases of the work of the College were held that day.

A cordial and extensive co-operation of local clubs, and civic, social, and other organizations was manifest at St. Paul. In acknowledgment of this, Dr. Frederic Besley and Mr. Raymond visited the Woman's City Club on the invitation of its president, Mrs. J. O. Sylvester, and made addresses on the work of the College and the necessity for thorough civic co-operation through the laity.

The meeting on hospital standardization in the Palm Room of the St. Paul Hotel was held at 2 o'clock in the afternoon. To this meeting were invited the chairmen and boards of trustees, superintendents, staffs, internes, and nurses of all hospitals in the States of Minnesota, North Dakota, Montana, and Wisconsin, together with those of the general public who were especially interested in hospital standardization. The meeting was very well attended, the Palm Room being practically full throughout the afternoon. The following program of addresses was carried out:

The Hospital Program of the American College of Surgeons—Franklin H. Martin, M.D., Director General, American College of Surgeons.

The Work of the Hospital Surveyor—Frederick W. Slobe, M.D., Hospital Survey Department, American College of Surgeons.

Hospital Standardization from the Standpoint of the Hospital Superintendent—A. B. Ancker, M.D., Superintendent City and County Hospital, St. Paul, Minnesota.

Hospital Standardization from the Standpoint of the Surgeon—Frederic A. Besley, M.D., Professor of Surgery, Northwestern University Medical School, Chicago.

The Soul of Standardization—Rev. C. B. Moulinier, S. J., President of Catholic Hospital Association.

Hospital Standardization from the Standpoint of the Laity—R. I. Raymond, M.A.

The discussions that followed the program evinced not only thorough co-operation on the part of hospital trustees, superintendents, and staffs throughout this section of the country, but

showed the leaven of the standardization idea working strongly among those whose interest had brought them to the meeting. The relationship of hospital standardization to the general medical profession and to the public, to the training of nurses, to present and future surgical research were points brought up and well thrashed out by voluntary speakers from the floor. Last and most important, the paramount interest of hospital standardization in the patient was so emphasized by all speakers as to prove beyond doubt that the ethical viewpoint of the College is simply a clear voicing to the public of the medical profession's own aims and earnestness.

If there is an outstanding characterization to be made of this hospital standardization meeting, it is that it was the farthest thing possible from a "mutual admiration society." For this section of the United States it is thoroughly evident that the hospital program has behind it not only interest and strong enthusiasm, but an enlarging quantum of spontaneous and farsighted planning for future hospital development.

The evening gathering at the People's Church was exceedingly well attended, more than 1,200 of the local and visiting physicians and laity being present. The program of the College was laid before the public by the following speakers with their subjects as noted:

The Program of the American College of Surgeons—Franklin H. Martin, M.D., Director General, American College of Surgeons.

What you Should Know about Cancer—Frederic A. Besley, M.D., Professor of Surgery, Northwestern University Medical School, Chicago.

The Community's Interest in Hospitals—Rev. C. B. Moulinier, S. J., President of Catholic Hospital Association.

The Layman's Debt to the College—R. I. Raymond, M.A.

Experimental Medicine—Its value to the Public—Charles H. Mayo, M.D., Rochester, Minnesota.

The speakers for the evening were there to bring clearly to the public the paramount importance of scientific medicine to the public itself, and the interest of the audience in this program was noteworthy for the fact that, although the meeting extended over two hours, only six persons left the auditorium.

Dr. Martin outlined briefly the history, scope, personnel, and advancing program of the College, as related definitely and directly to the welfare and needs of the laity. He pointed out the enormous strides made in surgical practice during the present generation, and indicated the pressing need for the most competent and thorough-going surgery and for the most thoroughly equipped surgical environment (the hospital) in order to maintain adequately the ethical relation between surgeon and patient. The Director General explained how the College proposes to accomplish both ends, and related concretely what has been done in both directions up to the present time. He called attention to the spread and influence of the College in Canada and South America.

Dr. Besley gave a very brief and clear outline of the early diagnosis and treatment of cancer, and plead with the laity on the very important point of early and thorough examinations, not only with regard to cancer but with regard to all diseases where surgical intervention may be necessary. The optimistic note of Dr. Besley's speech and the evident necessity for early diagnosis were received by the audience with marked interest.

The Reverend C. B. Moulinier presented eloquently the claims of hospitals throughout the country on the community's interest and completest co-operation. He laid the purposes of the hospital standardization program before the meeting in historic review. He outlined clearly and quickly the history of the movement within the College, explaining the concrete organization through which it is being accomplished, and gave the figures on what has been accomplished within the past 3 years of hospital visitation. The speaker stressed particularly the claim of the hospital on the layman's interest by citing the details of hospital standardization with regard to the staff, interneship, laboratory, and other clinical facilities, the hospital records—all instancing the dependence of the patient for his comfort and safety upon these latest and most advanced necessities to the equipment of truly scientific medicine.

Mr. Raymond laid before the meeting the debt of the public to the College for its open and unfailing championship of the lay rights and interests in urging and furthering self-standardization by the surgeons of the country and the adequate standardization of hospitals. The speaker endeavored to show how earnestly the College is seeking to remove the mystery of surgical procedure and to enlist the public's complete and understanding support of its program, which can only be of immense benefit to the laity and the medical profession alike. The speaker reviewed from the lay standpoint the pressing need for a public realization that early examinations should be submitted to, the moment there is the faintest indication of eventual surgical work. The past evils of incompetent surgery, inadequate hospital facilities, lay ignorance with regard to scientific medicine, public interference with extremely necessary features of expert surgery, such as

vivisection, and lastly the unethical, dangerous, and criminal practices that are met with in the practice of surgery, were the chief topics dealt with by this speaker. The absolutely reprehensible practices of the division of fees, and of operations practised "for instance," were unsparingly condemned, and a wide-awake and searching interest on the part of the public were bespoken toward the elimination of such medical practices.

Dr. Charles H. Mayo presented a fascinating address on the value of experimental medicine. To the natural interest of the public in an illustrated lecture there was added the interest of an exceedingly clear and simple presentation. The speaker was defending the practice of animal experimentation for the purposes of the general pathologist, anatomist, physiologist, and bacteriologist. He was especially happy in his choice of illustrations indicating the need for the employment of animals for vivisection, so-called. It is rather doubtful if the auditors had ever before had such a frank "taking-off of the lid" by a surgeon of such prominence. The keen interest evinced throughout this entire address indicates that the public has been anxious to hear, and quite open-minded to receive, information from the surgical profession regarding the actual meaning of experimental medicine, its thorough rationality, and its imperative necessity.

There was considerable quizzing of the speakers and of those known to be Fellows of the College by the local laity and physicians after the close of the meeting, both on the scope of the program outlined and the possibility of lay co-operation with the purposes of the College.

The labors of the visiting members of the College and its staff were greatly lightened by the activities of the local State Committee under the chairmanship of Dr. Thomas S. McDavitt.

SCHEDULE OF SECTIONAL MEETINGS FOR 1922

Nebraska, Iowa, and South Dakota at Lincoln, Nebraska, February 6–7.

Missouri and Kansas at Kansas City, Missouri, February 10–11.

California, Arizona, and Nevada at Los Angeles, February 17–18.

Texas, New Mexico, and Oklahoma at Houston, Texas, February 23–24.

Kentucky, Tennessee, and Arkansas at Memphis, Tennessee, February 27–28.

Alabama, Mississippi, Louisiana, Florida, and Georgia at Birmingham, Alabama, March 2–3.

North Carolina and South Carolina, Asheville, North Carolina, March 20–21.

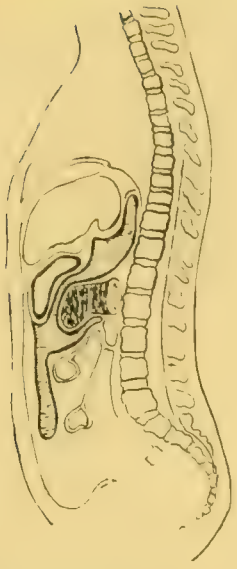


Fig. 1. Tumor of pancreas. Stomach in front, colon below.

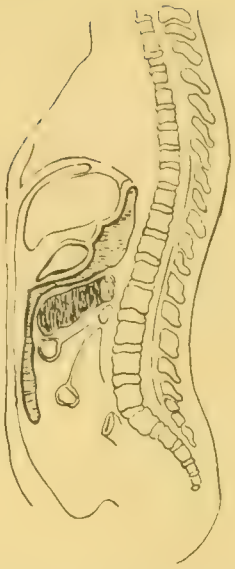


Fig. 2. Tumor of pancreas pushing forward between the posterior layer of the great omentum and the transverse mesocolon.

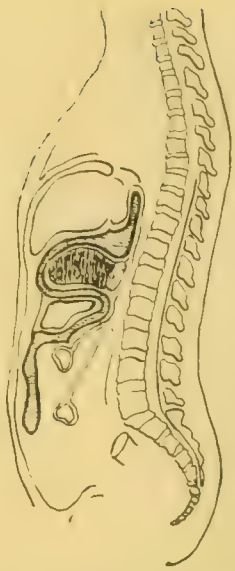


Fig. 3. Tumor of pancreas Stomach and colon both below.

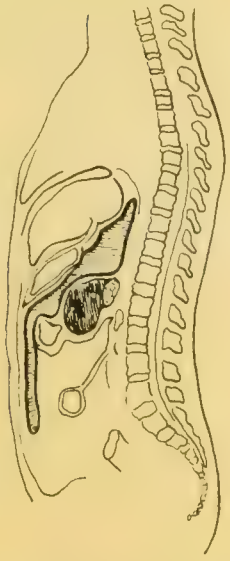


Fig. 4. Tumor of pancreas. Stomach and colon in front of it.

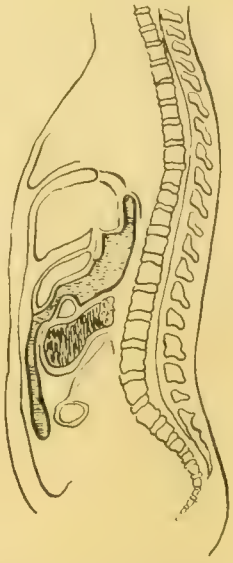


Fig. 5. Tumor of pancreas. Stomach and colon both above it.

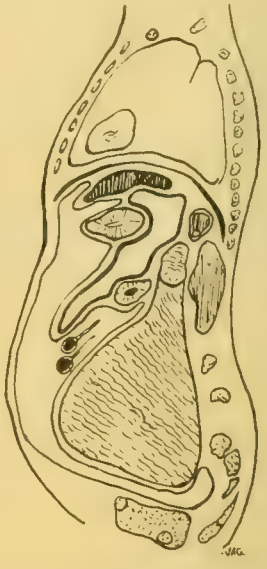


Fig. 6. Tumor, cyst of pancreas. Stomach, colon, and small intestine above and in front of it.

(Figures, 1, 2, 3, 4, and 5 from Robson and Moynihan.)

Pancreatic Cysts and Pseudocysts.—A. Primrose.

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PANCREATIC CYSTS AND PSEUDOCYSTS

REPORT OF A CASE OF TOTAL EXTIRPATION BY AN EXTRAPERITONEAL METHOD

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CYSTS of the pancreas are comparatively rare affections. The number of operations upon abdominal viscera, the world over, is now so enormous that even this rare condition has been encountered many times and individual cases being of special interest have been reported in the literature. It is, therefore, possible to study an extremely varied series of cases since Virchow described retention cysts of the pancreas in 1853.

The classification suggested by Robson and Moynihan in 1903 was as follows:

1. Retention cysts;
2. Proliferative cysts—
   Cystic adenoma,
   Cystic epithelioma;
3. Hydatid cysts;
4. Congenital cystic disease;
5. Hæmorrhagic cysts;
6. Pseudocysts.

To this list must be added dermoid cysts as the result of a recent communication by Judd in which he describes a cyst arising in the body and tail of the pancreas containing hair and one tooth. With this addition, however, the classification of Robson and Moynihan still holds good.

The association of acute and chronic pancreatitis with the formation of these cysts is well established, and, in turn the relationship between infection in the gall bladder and bile ducts as an etiological factor, direct as to pancreatitis and indirect as regards cyst formation, must be taken into account. In fact, it is asserted that the most common cause of cyst is chronic interstitial pancreatitis due to pressure on the ducts of the contracting connective tissue (Cammidge). It is suggestive that biliary colic and jaundice have been recorded as symptoms preceding cyst formation. Such a case was reported by McPhedran as long ago as 1897. Castronuovo reports a cyst of the tail of the pancreas in a man 60 years of age, a syphilitic who had hepatitis and perihepatitis with moderate icterus lasting 6 weeks. Ten months later he removed the cyst along with a necrosed portion of the pancreas. Ballin and Saltzstein have recently reported a case which clinically showed pancreatitis, cholelithiasis, cholecystitis, and subsequent to cholecystectomy the development of a pancreatic cyst, containing 4 quarts of brownish thin fluid. The gall bladder was removed because it was filled with stones. Some confusion at the moment exists regarding the correct method of utilizing our knowledge concerning the relationship here established. Thus Judd has noted the fact that cholecystectomy has effected a cure in certain cases of pancreatitis. He explains the sequence of events as follows: After cholecystectomy the bile dams up in the extrahepatic ducts causing dilatation; as this continues

the walls of the ducts hypertrophy until finally the resistance offered by the sphincter of Oddi at the entrance to the duodenum is overcome and a continuous flow of bile and pancreatic secretion, into the duodenum, ensues. On the other hand McWhorter argues in a logical fashion that the removal of the gall bladder, reducing as it does the pressure within the bile ducts, produced by the expulsive force of the muscular wall of the gall bladder, must effect a condition in which the pressure is not sufficient to overcome the resistance of the sphincter of Oddi. The result may cause regurgitation of the bile into the pancreas and the production or aggravation of pancreatitis. While recognizing the results obtained by Judd, we must consider the possibilities suggested by McWhorter, particularly in view of the case reported by Ballin and Saltzstein, and we are inevitably forced to the conclusion that Archibald is right in arguing, from his experimental and clinical evidence, which is most convincing, that prolonged drainage of the common bile duct in cases of pancreatitis is essential to effect a permanent cure. This may be accomplished with or without cholecystectomy. Koerte has reported a case in which after providing drainage of a pancreatic cyst he endeavored to establish drainage of the bile ducts by a cholecystenterostomy, the anastomosis being accomplished between the gall bladder and the jejunum. In this case the gall bladder at the time of operation contained 35 stones.

In many instances of pancreatic cyst formation there is a history of trauma. Kellock remarked on the frequency with which a kick from a horse on the abdomen was followed by this condition. Duschl records the case of a soldier who had a laceration of the duct of Wirsung as the result of a sharp blow over the stomach. This resulted in the formation of a cyst from the head of the pancreas. Not an unusual course of events is that described by Murray:

A boy, age 9, was run over by a delivery wagon. This caused a slight laceration of the pancreas producing hæmorrhage and the escape of pancreatic juice into the lesser sac of peritoneum. This was followed by a mild form of peritonitis resulting in the closure of the foramen of Winslow. The lesser sac became distended and a pancreatic cyst thus developed. The lad was operated upon 5 weeks after the accident, and recovered.

There are a number of instances in the literature of pancreatic cysts occupying the lesser sac of peritoneum. Walker reports an unusual case of a man suffering sudden acute abdominal pain after severe muscular effort. Three weeks subsequently a cyst, containing 2 pints of pancreatic fluid, was found in the lesser sac of peritoneum.

Koerte proposed the term pseudocyst for a fluid tumor found in more or less close proximity to the pancreas but not originating in the substance of the gland, the most frequent examples being those of effusion into the lesser sac of peritoneum as the result of injury to the pancreas. There is a great deal of confusion in recent literature in the use of the term pseudocyst; thus Koerte himself in a paper published in 1911 speaks of a pseudocyst as developing in a case of pancreatitis. However he believed that a chronic interstitial pancreatitis might result from injury. Others reserve the term for a pancreatic cyst having no epithelial covering, containing fluid surrounded by a wall of connective tissue formed within the pancreas or in contact with its surface, the contents being in part at least products of pancreatic secretion (Opie). The term pseudocyst has been restricted by Willis and Budd to those resulting from trauma. These have otherwise been called apoplectic cysts in which, as the result of the injury to the pancreas, hæmorrhage occurs and ferment may escape. The cyst wall is composed of dense fibro-elastic tissue. It is true that many cysts of the pancreas are lined by cylindrical epithelium but, on the other hand, the wall may be entirely devoid of epithelium. Koerte asserts that in true cysts the epithelium is often destroyed by the destructive effects of the pancreatic juice laying bare the underlying connective tissue. He remarks upon the remarkable fact that the epithelium is digested and the underlying connective tissue remains, while on the other hand we would consider the best defense against digestion to be the intact epithelium.

The existence of the products of pancreatic secretion in the cyst contents has been frequently noted. On the other hand

numerous instances of true cysts are on record where no ferments are found. Opie states: "The presence in cystic contents of one or more enzymes resembling those of the pancreas was formerly believed to give proof that a cyst had its origin in the pancreas. Not infrequently one or perhaps all of these enzymes are absent in the contents of a pancreatic cyst, whereas fat-splitting, diastatic, or proteolytic enzymes are found in fluids not derived from the pancreas."

To establish the diagnosis of a pancreatic cyst, the presence or absence of ferments would, therefore, appear to be of relatively little value; one must rely chiefly upon the anatomical relationship of the cyst to the pancreas. The occurrence of pancreatic tissue in the cyst wall would of course be conclusive, while the presence or absence of an epithelial lining is of little or no value in diagnosis.

The cyst may be unilocular or multilocular; they may be single or multiple. Bolt has recorded a case of polycystic disease of the pancreas. In this case the right kidney was also polycystic. Koerte has described a multilocular cystadenoma and Speese reports an unusual condition of a proliferating cystadenoma of the pancreas with extension to the abdominal wall 10 years after drainage of a pancreatic cyst. Hydatid cysts of the pancreas are recorded in the literature. An interesting case of this nature was recorded by my former colleague, the late Dr. George A. Peters, who succeeded in reaching the cyst by an incision through the loin and in effecting cure by evacuation and drainage. Parlavecchio obtained a cure in hydatid cyst of the tail of the pancreas after marsupialization and drainage.

The case which I have to record is a pancreatic cyst discovered in a woman immediately after the birth of her child at full term. There was no previous history to indicate its presence; it was of large size, invading the pelvis, and was mistaken for an ovarian cyst. Total extirpation was done with complete recovery. Following is a complete history of her case:

Mrs. B., age 32, a strong healthy woman was delivered of a child at full term on January 28, 1912. Prior to delivery the size of the abdomen was such that her physician in attendance thought it was a twin pregnancy. This belief was not dispelled when on the birth of the child, the abdomen remained large. It was soon discovered, however, that a large cyst filled the abdomen extending from the costal margin above, downward into the pelvis. This cyst was diagnosed as ovarian in origin and the writer was summoned to remove it, 6 weeks after delivery. On my arrival at the farm house the patient had already been prepared for operation, but, through the sterile towels one readily detected a large abdominal cyst. It was dull on percussion immediately above the pubes and in the flanks. It appeared somewhat elongated and did not present the characteristic spherical appearance of an ovarian cyst: its long axis was somewhat oblique from above and in the left, downward toward the center of the pelvis. The umbilicus was absolutely flat and showed no puckering, possibly this condition was produced by the great distention during pregnancy.

On opening the abdomen I exposed the cyst, which extended far down into the pelvis. I passed my hand below it and found it had no pelvic connections whatever. A layer of tissue lay over the cyst wall proper which proved to be the posterior parietal peritoneum. The small intestine lay above it and it soon became obvious that one had to deal with a retroperitoneal cyst which had developed downward and forward behind that portion of the parietal peritoneum which lies below and to the left of the attached portion of the mesentery of the small bowel. The right kidney and the spleen were in normal position. I incised the single layer of peritoneum which lay as a superficial covering over the cyst wall proper. The edges of the opening which I had thus made in the posterior parietal peritoneum were carefully stitched by continuous catgut suture to the edges of the opening which I had made in the anterior parietal peritoneum when I cut through the abdominal wall at the first. By this means I marsupialized the peritoneum, and by so doing I completely shut off the general peritoneal cavity while, at the same time, the cyst, partially bared of its peritoneal covering, lay in the bottom of my wound. I now proceeded to enucleate the cyst from its bed. This, to a certain point, was accomplished without much difficulty, but the posterior part of the cyst wall could not be reached. I, therefore, punctured the cyst with a large sized trochar and cannula, and drew off 5 litres of pale, chocolate-colored fluid, of the consistence of pea soup. I now continued the enucliation of the flaccid cyst wall: as I approached its base above and to the left it became more dense and more firmly connected, so that many vascular bands required ligation. Finally I narrowed it down to a pedicle containing an artery slightly larger than the radial and a vein as thick as one's forefinger. This pedicle lay to the left on a level with the body of the first lumbar vertebræ and was attached to the tail of the pancreas. I first separated the artery and ligated it; the vein with some adjacent tissue was then similarly

secured. The stump was sewn over by continuous catgut suture. In the cavity which remained I palpated and identified the left kidney. When the oozing from the cavity ceased I secured a drainage tube in place and otherwise closed the wound by silkworm-gut sutures through skin, muscle, and aponeurosis.

The operation lasted one hour: immediately after her return to bed the patient's pulse was 80 per minute and her general condition excellent.

The cyst wall was subsequently examined by Dr. O. R. Mabee and was found to be composed of fibrous tissue without evidence of any more specialized type of tissue.

The contents of the cyst were analyzed by Professor J. B. Leathes, who reported as follows: "The greenish, more or less opaque, fluid contained diastase in fair amount, but no evidence of trypsin or any protolytic enzyme nor of lipase. No urea was found but a small quantity of sugar by reduction test."

Dr. M. K. Dillane, who referred this patient to me, made careful inquiry into the previous history of the patient. As a young woman she suffered four or five times a year from "inflammation of the bowels," each attack lasting a day or two. She has been free from these for the last 8 or 9 years. She had acute rheumatism 10 years ago. She has never had any other illness.

It is now 9 years since I removed the cyst. She has enjoyed excellent health, and on December 27, 1915, 2 years and 9 months after the operation, she was delivered of a child at full term. There had been no discomfort during gestation and the parturition was normal in every way. The patient has remained perfectly well and no weakness has developed in the abdominal wall.

The treatment of a pancreatic cyst by marsupialization has been advocated and carried out many times. In this operation the cyst wall, after exposure, is sutured to the anterior abdominal wall, preferably to the skin, and the cyst is then opened and drained. In the case which I have just described, however, the marsupialization was accomplished by suturing an opening in the posterior parietal peritoneum to an opening in the anterior parietal peritoneum. The cyst wall was now attacked and was dealt with entirely outside the peritoneal cavity which had been shut off from the field of operation by the method described. As far as I have been able to discover, this method of uniting the opening in the posterior parietal peritoneum to the opening in the anterior parietal peritoneum has not hitherto been suggested or described in the treatment of pancreatic cysts. Hitherto it has been the wall of the cyst which was sutured in the process of marsupialization while in the method suggested and successfully carried out by me the peritoneum alone is sutured and the cyst wall is not included in the process.

Complete extirpation of a pancreatic cyst was first done by Tozeman in 1882 and since then has been successfully accomplished many times. Such cases have been described by Koerte, Willis and Budd, McCann, Moschcowitz, Roic, deFrancisco, Alexandrow, Gobell, Chand, and others. Mason records a remarkable case in which he removed three-fourths of the pancreas along with a cyst which had contained 4 quarts of fluid. Koerte quoted Gobell as stating in 1907 that the mortality after total extirpation was 10.7 per cent and after incomplete partial extirpation 55.5 per cent. The much higher mortality in the latter cases was accounted for by the insurmountable difficulties encountered in separating the cyst from neighboring organs (stomach, transverse colon, etc.) and from great blood vessels, and the damage done in the attempt to do so. In endeavoring to free a cyst the colon has been torn: adhesions to the stomach, duodenum or liver have precluded the possibility of enucleation. The portal vein has been found firmly embedded in the cyst wall (Robson and Moynihan). On the other hand the cyst may present no adhesions of moment: such was the case in the instance reported in this paper.

There are two factors to be considered regarding the anatomical relations of the cyst: first its point of origin from the pancreas, and second the relations established by the cyst as it enlarges and invades the abdomen. Regarding the first point it may be stated that a cyst may arise from any portion of the gland, head, body or tail. The tail of the gland is the most common seat of origin. The connection with the pancreas may implicate a wide area of the gland or it may be reduced down to a narrow pedicle. As to the relations established as the cyst enlarges one may state that occasionally it comes forward between the liver and stomach; it may push the stomach immediately in front of it; it may come between the stomach and the transverse

colon; it has been found between the two leaves of the transverse mesocolon, or again it may pass out below the transverse colon. The relationship established in my case must be unusual, in fact I have not been able to discover a similar instance. The cyst developed below and to the left of the parietal attached portion of the mesentery of the small intestine. On opening the abdomen the small intestine, transverse colon, and stomach all lay above the cyst. It is not surprising that a cyst developing from the tail of the pancreas should develop in the direction here indicated, the normal line and extent of attachment of the mesentery of the small bowel would readily permit it. The original diagrams of Robson and Moynihan (Figs. 1 to 5), which have been so frequently copied by other authors, are faulty in that they represent the possibilities of spread in the middle line only. The diagrams are those of a vertical sagittal section passing through the center of the bodies of the vertebræ. I have added a diagram (Fig. 6) taken from a frozen section of the body to the left of the spine and I have incorporated in this diagram the development of the cyst in my case, arising from the tail of the pancreas and spreading downward below and behind the small intestine. There are numerous instances on record in addition to my own where a pancreatic cyst has been mistaken for an ovarian cyst (Robson and Moynihan, McCann, and others).

The most common method of treatment hitherto employed for pancreatic cyst has been incision and drainage, with or without a preliminary marsupialization of the cyst wall. Robson and Moynihan refer to a remarkable case reported by Hagen in which the operator could reach the cyst only through the stomach. He divided first the anterior wall of the stomach and then the posterior wall. The cyst behind the stomach was then incised. He introduced his finger into the cyst and, displacing the stomach somewhat to the right, he succeeded in bringing a part of the cyst wall in contact with the parietal peritoneum. To this it was sutured and here drainage was established. The incisions in the stomach wall were sutured. The patient, a child of 13, recovered. Veller (quoted by Kerr) gave a record of 13 cases operated upon by evacuation and drainage in two stages; all the patients recovered. Drainage through the loin, as in Peter's case, has been recommended by some surgeons. Drainage of the ordinary type of pancreatic cyst usually results in a cure but a troublesome fistula may persist for a long period and the secretion therefrom may be of a very irritating character (McPhedran, Koerte, Walker, etc).

Pancreatic cysts have been found at all ages from young infants to individuals of three score years and ten. The most common period according to statistics of Koerte is in the third and fourth decades. Telling and Dobson describe a case in an 11 months old child, and these authors quote Railton as having recorded a case in an infant of 6 months. It would appear that they occur about equally in men and women. It is noteworthy that in several instances they have been discovered in women after confinement (McCann, Mayo). The significance of the relationship here is not apparent: in my case the cyst had attained large proportions and yet its existence was not suspected until immediately after the birth of a full-time child.

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THE DIAGNOSIS AND TREATMENT OF SOME COMMON INJURIES OF THE SHOULDER JOINT[1]

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AS the peculiar manifestations of injury and inflammation in the shoulder joint seem conditioned by its peculiar structure, it may be permissible first to review certain anatomical and mechanical conditions existing in it as a preliminary to the consideration of the clinical manifestations.

1. The shoulder joint in the quadruped acts as a weight-bearing joint, but in the course of evolution it has ceased to bear weight and in the upright position must support the weight of the arm—in the adult probably amounting to 10 or 15 pounds. It, therefore, has become transformed from an asset to a liability. This considerable weight for the great part of the time drags more or less vertically down upon the joint because in the upright position the humerus is, most of the time, at the side, while the elbow and wrist are much in action in daily life and carry much less weight. The important practical point is that the shoulder supports a very considerable weight and is a purely hanging joint.

2. This weight is not supported by the capsule to any large extent, but by the muscles, mainly the biceps, the triceps, coracobrachialis, and deltoid. If these are paralyzed the humerus drops away from the acromion, and in the cadaver if these muscles are divided the humerus falls away about an inch. In no other joint in the body do ligaments fail to hold the joint in place against gravity.

3. The joint possesses the greatest range of motion of any of the joints and is movable in all directions, and at no one time is any considerable part of the head of the humerus in contact with the shallow glenoid cavity. Extremes of motion are checked by capsular and ligamentous tension and support by the tendons of certain muscles.

4. The shoulder joint is not firmly connected with the skeleton, but is mounted on a movable base, the scapula. Abduction of the arm depends on fixation of the scapula, and before the movement can be made, the trapezius and rhomboids, pectoralis minor and serratus magnus must hold the scapula firmly, and when even the trapezius is paralyzed, abduction of the arm is slight or absent even if the deltoid is good. This relation of the scapular muscles to all shoulder motion is important, and is the dominating consideration in estimating the effect of ankylosis of the joint, because although ankylosis in abduction is the position of choice with a movable scapula, if the scapula is immobile for any reason, fixation in abduction is a calamity.

5. The relation of certain muscles to the joint structures is most intimate, and most important to remember. The tendon of the subscapularis is closely merged with the front of the capsule, and between it and the capsule at one point is a bursa communicating with the joint. The long head of the biceps passes through the joint capsule encased in a synovial tube. The supraspinatus tendon passes across the upper part of the capsule, to which it is adherent, to be inserted into the greater tuberosity. The infraspinatus tendon passes across the posterior surface of the capsule, and the deltoid muscle is separated from direct contact with the joint only by the subdeltoid bursa, and the tendons mentioned.

6. The subdeltoid or subacromial bursa is about the size of a silver dollar, but this is variable and does not generally communicate with the joint, but it lies very close to it, its floor being separated only by the tendons of the short rotators. Its base is formed by the tuberosity of the humerus and the tendons of the rotators, and its roof is attached to the acromion and acromioclavicular ligament. Its relation with the joint structures is, therefore, most intimate. The bursa under the subscapularis has been mentioned,

[1] Read by invitation before the Chicago Surgical Society, December 2, 1921 (For discussion see page 553).

there is also one under the infraspinatus tendon and several others of minor importance.

7. The final point of surgical importance is the muscular balance. We have two very powerful muscles—the pectoralis major, and the latissimus dorsi, which pull the arm in to the side by a direct straight pull. We have one large and one smaller muscle—the deltoid and supraspinatus, which pull the arm away from the side, both of the latter working under unfavorable conditions of leverage, and dependent even then on the fixation of the scapula by the trapezius, and other muscles. Moreover, the first action of the deltoid must be to lift the arm vertically until the head of the humerus impinges on the upper part of the joint before it can become an abductor; the supraspinatus, is however, an abductor from the start as can be seen from its line of pull. In short, the effect of muscular balance is to favor an adducted position of the arm.

Briefly then, we have a weight-carrying, loose ball-and-socket joint, kept in contact in large part by muscular action, and this joint is most intimately connected with important tendons and bursæ which enter into its structure. Injuries must be complex in most cases from the purely geographical association of many different structures.

It is not necessary to do more than to define the cases under consideration for every clinic is haunted by them, and every surgeon sees them constantly, the picture being familiar to all. After a wrench or overuse of the shoulder, perhaps after exposure to cold, or in connection with some slight systemic infection, the shoulder becomes painful and irritable, it soon becomes impossible to abduct the arm to its full extent actively, and pain is likely to be felt at the insertion of the deltoid at the outer aspect, especially in the later stages. Active or passive rotation becomes restricted and uncomfortable, but forward motion persists after the other motions have disappeared. The arm becomes especially painful at night, and it wakes the patient when he turns on his side. While the stiffness remains incomplete, the two most painful motions are to fasten the suspender buttons or skirt bands at the back, and to fasten the collar at the back of the neck. As the affection progresses the arm becomes stiffer in the more acute cases and the only abduction allowed is that obtained by the motion of the scapula, and the patient learns to hold the elbow up and close to the side with the other hand. Atrophy of the arm and shoulder muscles occurs. A most uncomfortable condition results, and there is little tendency to spontaneous improvement, so that the patient, and sometimes the surgeon become discouraged.

DIAGNOSIS

In many localities the diagnosis of subdeltoid bursitis is the usual one made in these cases, and I quote Codman's view, who has been a pioneer in the study of this subject: "More patients seek hospital treatment for lesions of the subacromial bursa than for all other lesions including tuberculosis and fracture taken together." And again the following quotation may be made: "I believe that it will be found that most minor lesions of the shoulder joint involve the bursa and few involve the true joint." The very great frequency with which this diagnosis is made, in some parts of the country at least, leads to the question, for reasons which will be given, whether it does not belong to a class of stock diagnoses often made by surgeons on what would seem to be insufficient evidence. A "torn ligament" is often diagnosed where the evidence would seem to warrant only the term sprain, yet the explanation that the ligament is torn seems to the patient to warrant discomfort for months, really often only the result of a badly treated simple sprain. The term "neuritis" is very carelessly used by surgeons for the explanation of all sorts of pain, and is very popular with the laity who make the diagnosis themselves with great freedom, imposing on a surgeon, who sees much of the surgery of chronic cases, a large burden in the way of explanation. "Dislocation of the sacro-iliac joint" is a very popular diagnosis in many parts of the country, but so far X-ray and pathological evidence of its existence, except from great trauma, is wanting. "Dislocation of the semilunar cartilage of the knee" is an easy

explanation of slow and obscure knee-joint injuries. In place, therefore, of using the diagnosis of subacromial bursitis as the routine one in these injuries we will do better to look further and see if a more exact and descriptive diagnosis cannot be reached. For this purpose it is important that any data which we have for identifying and localizing injury of this region should be used with a view of obtaining accurate information.

In many shoulder-joint injuries, so many structures are involved that it is impossible to identify any one as the especial one involved, and it may be necessary in these cases to use the time-honored term "sprain" in speaking of the acute cases, and in the chronic cases to resort to the old diagnosis of periarthritis, which is at least descriptive and a better guide to treatment than the assumed diagnosis of the involvement of some special structure, if such diagnosis cannot be established by adequate clinical evidence. But an accurate anatomical diagnosis can only be made when the injury is confined to special structures, and we must use the anatomical data in our possession for this localization.

Sprain. A sprain may be due to a stretching or tearing of the capsule or ligaments, to injury of the synovial membrane, or to the extravasation of blood into the tendon sheaths or any of the structures surrounding the joint. The grave after-effects of sprain or periarthritis, as one may call it in the later stage, are also most manifest in the limitation of abduction and rotation, and the irritating effect of the weight of the arm as already mentioned.

Muscular strain. If a definite muscle suffers from strain it will be painful if it is actively contracted, and still more painful if the voluntary attempt to contract it is resisted, or if it is passively stretched, and the pain is most likely to be referred to either the origin or the insertion of the muscle. If any fibers have been ruptured, there is likely to be also acute pain on pressure at the spot of rupture and varying amount of hæmorrhage at the same site. If many muscular fibers are torn and the muscle is superficial, a prominence may occur at the site of the rupture when the muscle is put into action. This prominence cannot be found, and the signs of hæmorrhage are less clear in rupture of the deeper muscles.

The most common muscles about the shoulder joint to be strained are the deltoid, the biceps, and the internal rotators, while the external rotators are rarely seriously injured in this way. In the case of the deeper muscles, the diagnosis must be made chiefly by impairment of function and pain on use as described. It must be remembered, however, that in the involvement of the shoulder muscles, passive motion in a certain direction may be allowed, while the active motion is painful. This is particularly noted in abduction when the surgeon may often lift the arm from the side without pain, but if the patient attempts to hold it in this abducted position severe pain is felt at the insertion of the deltoid muscle.

To make an accurate diagnosis of muscle strain, one must have fresh in his mind the action of the most important muscles which may be mentioned. The *deltoid* raises the arm from the side, but it is assisted in so doing by the supraspinatus muscle, so that limitation of abduction does not mean necessarily that the deltoid is affected, because tenderness at the insertion of the supraspinatus muscle will also limit abduction. It must be remembered also in making the diagnosis of deltoid strain, especially in the later cases, that immediately following the injury muscular atrophy begins, and of all the muscles supporting the arm the deltoid suffers most, and the pain so commonly experienced at the insertion of the deltoid in shoulder-joint injuries is an instance of this. That is to say, strain of the deltoid, unless detected immediately after the accident, may be the result of the drag of the weight of the arm on the deltoid and complicate the picture.

The biceps. The function of the biceps is three-fold: to flex the forearm on the arm, to supinate the forearm, and to raise the whole arm forward from the frontal plane of the body. To detect injury of the biceps tendon one starts with attempted flexion contraction of the muscle with the arm at the side and the movement resisted. The

movement of supination of the forearm should cause pain at the site of the long head of the biceps. Tenderness over the biceps tendon should be found in the bicipital groove of the humerus, with which may be associated in this location swelling and soft crepitus when the biceps is used, detected either by the finger or the stethoscope.

Internal rotation. The important muscles producing this are the pectoralis major and the subscapularis. The pectoralis major is accessible to palpation throughout its course, and pain in internal rotation combined with local tenderness in the pectoralis major would establish injury of that muscle. Pain in internal rotation, when there is no local tenderness in the pectoralis cannot, however, be assumed as certainly establishing injury to the subscapularis muscle, because the latter is so closely associated with the anterior part of the capsule of the joint and the bursa which separates it from the base of the coracoid process that a resisted attempt at internal rotation might result in pain, not only from the involvement of the subscapularis, but also from injury to or inflammation of the capsule in that region. If local tenderness to palpation is not present in the pectoralis major muscle, and internal rotation is painful it may be assumed that the injury is to the subscapularis tendon or the anterior capsule of the joint or to both.

External rotation. External rotation is produced by the infraspinatus, aided by the teres minor. The infraspinatus is one of the most important protections to the joint, supporting it from behind, but is not commonly affected by muscle strain. It would be detected along the same lines indicated.

What has been said about muscular strain applies equally well to the strain of their tendons and in the latter case it may be possible to detect the crepitus of tenosynovitis.

Synovitis. Proceeding in the matter of the differential diagnosis of shoulder-joint injuries, we come next to the condition of acute synovitis, which occurs here as in the other joints, but is less frequent in a typical form than in the knee, for example, for the reason that the capsule plays so small a part in the support of the arm and limitation of arm movements, and so large a part is taken by muscles. For this reason muscular injuries in the shoulder joint are more prominent than elsewhere, and purely synovial injuries less frequent.

In acute synovitis or arthritis or involvement of the shoulder joint in arthritis deformans, rotations are the first movements to be limited, followed closely by abduction. Pain on pressure is usually acute over the most superficial part of the joint below and outside of the coracoid where the synovial membrane is most accessible, and there is some sense of deep swelling. In this condition also, in its later stages, pain is frequently found referred to the insertion of the deltoid muscle. If acute symptoms continue, it passes into a subacute condition, which may be described as arthritis or periarthritis, in which the symptoms as described as characteristic of the acute stage persist.

Rupture of the supraspinatus insertion. After a fall and sometimes after severe exertion, as in golf, symptoms are felt in the shoulder joint consisting of a severe reaction in the joint associated with inability to abduct the arm and tenderness over the tip of the shoulder. Attempts to raise the arm from the side are excessively painful and felt in the shoulder, and if the condition is not recognized and remedied, the disability in the shoulder still goes on but diminishes until all that remains of it is an irritable arm with inability to abduct without discomfort, and a dragging sensation frequently referred later to the outer side of the arm. Two types of this injury may occur. In the first the supraspinatus tendon may be ruptured in part or wholly, in which case the diagnosis is not always clear, but more frequently it pulls off a piece of bone from its insertion, which is perfectly evident in the X-ray by the appearance of a detached piece of bone, and the cavity in the bone made by its detachment can generally be detected. This injury was particularly emphasized by Codman, who frequently found the tendon frayed out in dissecting room subjects, and in operation on the subacromial bursa. The relation of the tendon and the bursa is so

intimate that a partial rupture of it would be very likely to be associated with reaction in the bursa.

Bursitis. Up to this time nothing has been said of the involvement of the bursæ of the shoulder joint which are numerous and important. One or two of them communicate directly with the shoulder joint and must obviously be involved in any inflammation of that joint.

The subdeltoid bursa is in close contact with the structures of the joint and our attention must next be directed to that. The diagnosis of subdeltoid bursitis is so frequently made that it seemed worth while to go over the whole literature of the subject with a view to seeing what symptoms were described as characteristic to that particular injury, because in my own experience I saw so many cases diagnosed as subdeltoid bursitis that really on investigation and in their subsequent history seemed to be clearly lesions of the character described above, and not bursitis at all. It was impossible to find in this very extensive literature any symptoms essentially diagnostic of this condition, except in those cases where loose bodies were felt in the bursa, or where the X-ray showed either calcification in it, or a dense cloud in the soft parts limited to the region of the bursa, sometimes seen in an X-ray taken with a soft tube.

There is no question whatever that this bursa is from time to time injured and inflamed, but in certain of those cases the involvement of the bursa may be secondary to joint involvement. Tenderness over the bursa and the fact that limitation of abduction was partial in bursitis, and total in arthritis were dwelt on as characteristic but it is obvious that either or both of these may exist in the conditions described above. The sign described by Dawbarn where tenderness over the bursa exists but disappears when the arm is abducted and the bursa slides under the acromion may be of use, but as the arm is very early fixed at the side, abduction is impossible. It needs only a glance at the anatomy to see that this bursa must share in extensive inflammations of the joint, and in injuries and inflammation of the tendons of the supraspinatus and infraspinatus and subscapularis.

This diagnosis is an important one, because on it may depend the question of operative interference which obviously should not be undertaken without very definite signs of the existence of the condition, and undertaken then only with a very definite idea of what is to be accomplished by operation

TREATMENT

The treatment of injuries of the shoulder joint has almost defined itself by what has been said in speaking of the anatomy and mechanics of the joint. There are two essential requirements:

1. The arm should be abducted from the side and held there in order to take off the weight from the capsule and supporting muscles, and to relieve pain.

2. The abducted position is necessary to counteract the pull of the two strong muscles —the pectoralis major and the latissimus dorsi, which if not antagonized will become adaptively shortened, hold the arm to the side, and promote the occurrence of adhesions in the adducted position, and these adhesions are a real menace as they may occur in the capsule, periarticular tendons, and bursæ.

The use of a sling is unsatisfactory treatment and is responsible for a good deal of the after trouble that we have in treating these cases. It takes off part of the weight of the arm from the supporting structures, but favors the occurrence of adhesions in the adducted position and adaptive muscular shortening. It is, of course, perfectly good treatment to use a sling in the treatment of very light cases which are doing well, but as soon as any limitation of abduction appears or if it is originally present, to continue the use of a sling is to bid for trouble. The use of a platform splint, unsightly and conspicuous as it is, is the only efficient treatment for moderate and serious injuries of this type in the shoulder joint. The splint may be made of wire, plaster of Paris, or any other material; it should hold the arm at a right angle to the long axis of the body, and the elbow should be if possible in the frontal plane. In very acute cases, however, it will be impossible

to put the elbow as far back as this at first, and a position in front of this will then be preferable. The elbow should be flexed at a right angle, and theoretically the forearm should be vertical, as internal rotation as well as adduction should be antagonized. But in the majority of cases, perfectly satisfactory results are obtained if the forearm is horizontal. This splint is not worn at night except in very severe cases, and if it is to be worn at night, plaster of Paris would be better than the wire. Light massage and measures to stimulate the circulation are apparently useful as soon as the acute stage is over, followed by active exercises for the abductors, external rotators, and scapular muscles, but early massage often excites a reaction, while electric light baking of the shoulder can be generally tolerated and improves the circulation.

No common injury that we meet, except possibly injuries to the spine, is so badly treated as injuries of the shoulder joint, and one relief that these patients receive from operations on the bursa is perhaps because following these, the arm is fixed in an abducted position.

Adhesions. The majority of cases, when they consult the surgeon, have already acquired adhesions in the adducted and inwardly rotated position, the arm is exceedingly painful and intolerant of manipulation, and unless something is done there is no prospect of immediate improvement. As under these conditions massage is not tolerated and nagging passive movements are irritating, the best course to pursue, in cases where practically no abduction is allowed, is to fix and support the arm in a position as much away from the side as possible without discomfort, by the use of a sling for support and a pad between the elbow and the body to secure abduction, the size of which pad should be gradually increased.

It will be found in nearly all cases that the patient or someone connected with him is trying to stretch the arm and keeping it constantly irritated. The use of fixation under these conditions will result even in the worst cases in quieting the symptoms, after which the real treatment may be undertaken by gentle passive stretching, given without anæsthesia, at first every second day, by the surgeon. Small gains may be obtained which are held by increasing the abduction of the arm. A platform splint may then be put on which will maintain only a few degrees of abduction, and this angle of abduction should be from time to time increased, but it is never wise to increase it to the point of irritating the joint, and the level of the arm should always be a little short of the maximum obtainable. As the irritability quiets down, more and more force may be used in the manipulation, and the angle of the splint increased, but it must rest entirely with the judgment of the surgeon in his manipulations not to use enough force to excite a reaction which does not quiet down within 48 hours. Much reaction would mean an increased danger of adhesions, and every second day is at first often enough. Light adhesions will be felt to rupture during such manipulation from time to time. In addition to manipulation in abduction, external rotation must be restored and the arm must be brought back until the elbow is in the frontal plane of the body. After each treatment the arm should be put back on the abduction splint and massage continued. The process is a very slow one and continues for weeks in bad cases.

If progress is checked by coming up against an obstacle that cannot be overcome by the use of moderate force, or if it is impossible to give the time to the treatment, manipulation under anæsthesia becomes advisable, but *not* during the acute stage. After the symptoms have quieted down sufficiently to warrant it, the patient is anæsthetized fully, and unless severe resistance is encountered the arm should be put through its full range of movement in abduction and outward rotation, and the manipulation should finish with the hand behind the head and fixed in this position until the patient is well out of anæsthesia. This position is obtained by Brickner by tying the wrist to the top of the bed, the head of which is raised by blocks. The patient should begin at once to move the arm voluntarily, even if painful, as it restores his confidence and is much safer than passive

motions. If a very severe resistance is encountered in manipulation, it should be abandoned for the time being, the arm fixed in as much abduction and outward rotation as possible, and the remainder of the process conducted by manipulation by stages under anæsthesia, gaining what may be safe each time, fixing the arm in the best obtainable position, and when full correction has been obtained, active movements, even if painful, should be gone through by the patient, but passive movements are to be avoided when painful.

Operative treatment. There are two conditions requiring operation in connection with injuries of the shoulder joint. If the supraspinatus muscle has been torn away, carrying with it a piece of bone, the arm should be placed in an abduction splint and an X-ray taken with the arm fully abducted. If the X-ray shows the fragment of bone in place, the treatment should be continued in this position until time has been given for the fragment to unite. If it is not then in satisfactory position, it is advisable that an operation should be performed. The operation of choice is the one described by Robert Jones. An incision like the cut of a sabre is made straight across the shoulder through the acromioclavicular articulation which is divided, and continues posteriorly below the spine of the scapula at the origin of the acromion process. A gigli saw is passed beneath the root of the acromion and the process divided from the spine of the scapula. The deltoid is now turned outward and downward giving complete exposure of the floor of the bursa, and the fragment is fixed in its proper position by a pin. The acromioclavicular joint is sutured and the acromion falls back into place where it has been separated, and the arm is immobilized in abduction, and there is little likelihood of displacement.

The other condition demanding operation is that in which a chronic bursitis of the subdeltoid bursa has been clearly established, which has not yielded to the measures described in speaking of the treatment of shoulder-joint injuries, or where the calcification of the walls of the bursa is clearly demonstrated. In this case the bursa is opened by an incision through the deltoid muscle exposing the roof of the sac. If this is opened the floor of the bursa is exposed and the tendons of the short rotators are seen just below the floor. Adhesions are broken up, villous masses removed, and calcareous deposits identified and scraped away or dissected out. If there is reason to suspect an injury to the tendon of the supraspinatus, its sheath should be incised in its length and the tendon repaired. The dissection out of the whole bursa is impossible as it is attached to the tuberosity of the humerus and to the acromion above, and routine attempts to dissect out the bursa in slight cases should be discouraged.

Irritable arm—false neuritis. Any consideration of injuries to the shoulder joint would be incomplete without mentioning one very troublesome condition which must be constantly seen by all surgeons, and which has not, apparently received much attention, which may best perhaps be spoken of as a painful or irritable arm, and is exceedingly common in practice. In certain patients, particularly nervous and overworked women, symptoms wholly out of proportion to the cause follow slight injury and overuse to the shoulder joint, or may appear without known cause. The injuries are more often slight strains or excessive use of the muscles in persons with poorly developed shoulder muscles, and in the cases seen, atrophy of the shoulder muscles has been a universal accompaniment, often reaching a high degree, and would seem to be the important factor in causing pain. Soon after the injury or overuse an extremely painful condition involving the whole arm arises, and the diagnosis of neuritis is almost always made, although legitimate symptoms of neuritis are absent. There is no disturbance of sensation, no tenderness over the nerve trunks, and no swelling of the hand. The arm feels heavy and aches after use, particularly some time after use, and wearing a heavy coat or carrying a bag on the affected side gives rise to great discomfort. There is tenderness to pressure at the root of the neck, and on the affected side the arm is carried at the side very often in a sling and is exceedingly

irritable. As a result of this position the motion of abduction becomes limited from adaptive muscular shortening of the pectoralis and latissimus muscles and perhaps later by adhesions, and abduction, even passively performed becomes limited and painful. Massage, except of the gentlest grade, is irritating and as there is generally later some limitation of abduction, by attempted use the joint is continually irritated.

The condition apparently goes on indefinitely. It would hardly be fair to say that it is always associated with neurasthenia, but the patients appear to have a well-organized nervous system and to be as a rule in poor general condition. The diagnosis of neuritis is accepted by the patient as explaining everything.

The treatment that has been most successful has been to use a sling to take off weight, to give the gentlest possible massage to improve the circulation and muscular tone, along with the use of radiant heat, and to begin as soon as possible exercises to develop certain shoulder-joint muscles. The biceps and triceps, for example, can be exercised without moving the joint. The severest cases will require the use of an abduction splint, and if adhesions are present they must be stretched by passive manipulation in abduction when acute irritability begins to diminish and then active developmental muscular exercises must be begun and continued.

The attempt has been made in this paper to call attention to certain perfectly well-known anatomical and mechanical conditions which apparently dominate the behavior of the injured shoulder. We are too apt to forget the weight of the arm and the inevitable muscular drag which must result when the muscles lose their proper tone, as all muscles of an injured joint must do at an early stage. As a result of this muscular pain and irritability we have the well-known dragging pain, especially notable at the insertion of the deltoid, the chief sufferer from this weight. Neither must we overlook the exceedingly complex nature of the joint and the intimate relation of tendons and bursæ to capsule. Injury of one structure alone must be rare, for the contact of different structures is too close to prevent it in most cases.

The moral that I would point out is that we should regard the shoulder joint as a whole when we treat its injuries, and not allow ourselves to find the explanation of all symptoms in the assumption of the inflammation of one bursa, an inflammation which frequently exists, but which does not adequately in many instances explain the symptoms present. And finally, I would plead for the primary fundamental requirements of fixation in abduction from an early stage.

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THE DIAGNOSIS AND TREATMENT OF TUBERCULOUS EMPYEMA

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TUBERCULOUS empyema may be defined as a type of suppurating pleurisy in which the tuberculosis bacillus is either the sole infective organism or is one of the organisms of a mixed infection. Dry adhesive pleuritis, pleurisy with serous effusion, and suppurative or hæmorrhagic pleurisy constitute different grades of reaction to pleural infection. The extent of the pleural reaction is in proportion to the virulence of the infection and the resistance to it.

From a pathological point of view, tuberculous pleurisy may be subdivided into primary and secondary forms. To the first belong the cases of initial involvement of the pleura; to the second, cases following lesions of the lungs, chest wall, or glands. Some writers consider all cases of tuberculous pleurisy secondary to pulmonary involvement. Cases occur, however, in which there is no demonstrable focus in the lung. In such instances the lung tissue possibly furnishes only the avenue of infection.

Primary tuberculous pleurisy with or without effusion, which has its analogue in primary tuberculous peritonitis, probably occurs more frequently than is generally recognized. Hodenpyl found nodules and patches on the visceral pleura in 44 of 91 cases in which the lungs were free from tuberculosis. These nodules were proved to be tuberculous by microscopic examination in 41 cases, and in 3 without nodules foci of tuberculosis were demonstrated microscopically. Hodenpyl regards this type of involvement as the most likely to heal spontaneously. To the same group belongs probably a large proportion of the cases of primary adhesive pleuritis and pleurisy with effusion. The analogy to tuberculous peritonitis of the dry plastic and ascitic types is striking.

The question of the etiology of primary or idiopathic pleurisy with effusion is of especial importance in the consideration of tuberculous empyema. Although Cabot, Rist, and Webb expressed doubt with regard to the tuberculous nature of the primary serous effusions observed in the American Expeditionary Forces, there is much evidence to substantiate the view commonly accepted, that save for an occasional instance of effusion complicating unrecognized pneumonia, these are tuberculous in nature. This evidence is furnished by the investigation of the further history of cases of pleurisy with effusion, and by a study of the fluid. Series of patients whose course is followed for from 5 to 20 years show that from 35 per cent to 55 per cent eventually die of tuberculosis (Osler, Hedges, Sears, and others). Insurance companies find that deaths from tuberculosis among persons having had pleurisy with effusion is three times the average (Norris and Landis). Of special interest is a series of Koester, who found that of 514 patients 245 became tuberculous. About 50 per cent of the patients had active lesions before the end of 5 years, but a latent period of 10 years or more was noted in about 7 per cent of 164 cases.

The demonstration of tuberculosis bacilli in the serous exudate constitutes the most convincing evidence of its tuberculous nature. Direct examination of the sediment obtained by centrifugalizing the digested clot, the so-called inoscopy of Jousset, and animal inoculation, have yielded positive results in from 20 to 85 per cent of the cases. The widely divergent results are probably due to differences in technique, and in the animal inoculations to the varying virulence of the bacilli. By inoscopy positive results were obtained in 20.8 per cent in a series of 115 cases at the Massachusetts General Hospital (Goodall); in 65 per cent by Zebrowski; in 45.4 per cent in a series of 51 cases reported by Musgrave and in 100 per cent in 20 cases reported by Jousset. Animal inoculation yielded only 33 per cent positive results in Musgrave's series, but Daminy, using 300 cubic centimeters of exudate in divided doses of 10 cubic centimeters each, obtained positive

results in 48 of 50 cases. Spengler states that he has always been able to demonstrate tuberculosis bacilli by using 200 cubic centimeters of exudate aspirated from the lowest portion of the pleural cavity. Musgrave demonstrated the bacilli by inoscopy in 8 cases in which the guinea pig test was negative. The varying virulence of the bacilli is indicated by the fact that he obtained negative results in three animals injected with three successive tappings, but 6 months later obtained a positive result Barjome and Cade also found that only one of three or four animals gave a positive test. These experiences emphasize the uncertain significance of a single injection of a few cubic centimeters of fluid in one animal.

Musgrave regards a positive tuberculin test and a relatively large percentage of lymphocytes in the exudate as of diagnostic value.

A serous effusion may persist for months and recur after repeated tapping (Fyfe), or it may promptly subside after one or two aspirations. Patients should not be repeatedly tapped, however. If the effusion persists, it may remain serous, or, as often happens, especially after frequent tapping, it may become purulent. Very little seems to be known regarding the conditions which govern these changes. Floyd concludes from an experimental study, injection of dead and living pyogenic bacteria into the pleural cavity, that the varying reactions depend on the relative virulence of the organism, and that when there is but little chemotaxis, pleurisy with or without effusion results, but that if the chemotactic action is profound and the elaborated toxin not too destructive, empyema results. Opie, on the other hand, using graded amounts of turpentine as the pleural irritant, which produces effusion, found an increased tendency to purulent change following aspiration of the fluid. He believes that this difference may be due to an increased activity of the leucoprotease of the polynuclear leucocyte normally held in check by the anti-enzyme of the exuded serum.

In contrast to the cases of primary idiopathic pleurisy are pleurisy in the lung, chest wall, or glands. The common pneumonic pleurisy with or without effusion is an analogous condition. Lord found a serous effusion in 5.2 per cent of 1185 cases of pneumonia, and Musser reports 5 serous and 20 purulent effusions in 127 necropsies following pneumonia. In the recent epidemic of streptococcus infection, pleural effusion was the rule.

Tuberculous infection of the pleura is a common concomitant of pulmonary tuberculosis. Osler writes that the visceral pleura is always involved. The frequent resultant partial obliteration of the pleural cavity may account for the fact that a relatively large proportion of cases do not develop late effusion. In the absence of obliterating adhesions, the pleural cavity may become grossly infected by the rupture of a subpleural focus, producing a spontaneous pneumothorax. This occurs in from 4 to 10 per cent of institutional cases of tuberculosis (Gutmann, Eichorst, Cruice). The presence of apical pleurisy should be considered as a benignant process of conservation. This complication is usually announced by marked symptoms. A mixed infection usually results, which makes the prognosis grave. Spontaneous pneumothorax, however, may have an insidious onset, and not give rise to marked symptoms. Such cases are of the "latent, mute" type of pneumothorax which are most liable to develop a purulent effusion (Bouchut and Gravier). Baeumler reports two cases in which the exudate remained serous in the presence of pneumothorax.

Tearing the lung by band-like adhesions occurs as a complication of the pneumothorax treatment of pulmonary tuberculosis (Cocke, Marshak and Craighead, Webb, and others). Duboff reports 10 cases of effusion in 48 of which artificial pneumothorax had been used. Spengler states that an effusion resulted in 50 per cent of 100 such cases. He believes that the exudation is due to loosening up of pleural adhesions.

The bacteriology of undrained tuberculous empyema has been less well studied than has that of tuberculous pleurisy. Netter (59), in a series of 109 cases of purulent pleurisies, found tuberculosis in 15.2 per cent, but in 13

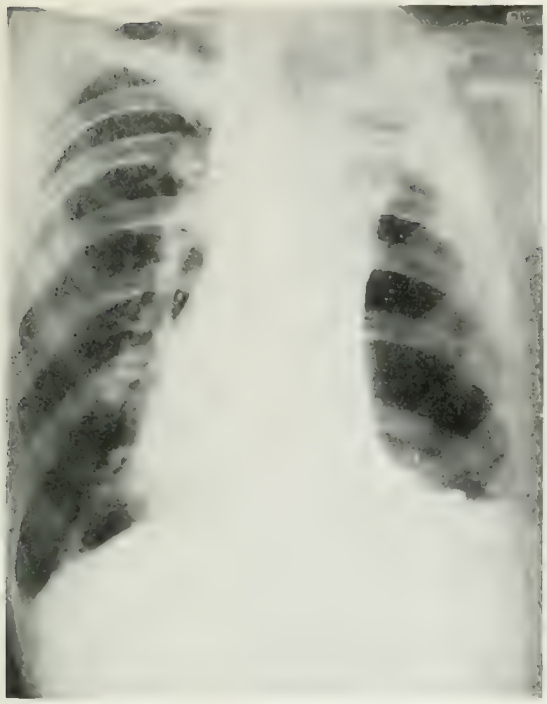

Fig. 1. Case 185290. Chronic tuberculous empyema of about 3½ years' duration with almost complete collapse of the lung, September 19, 1919.

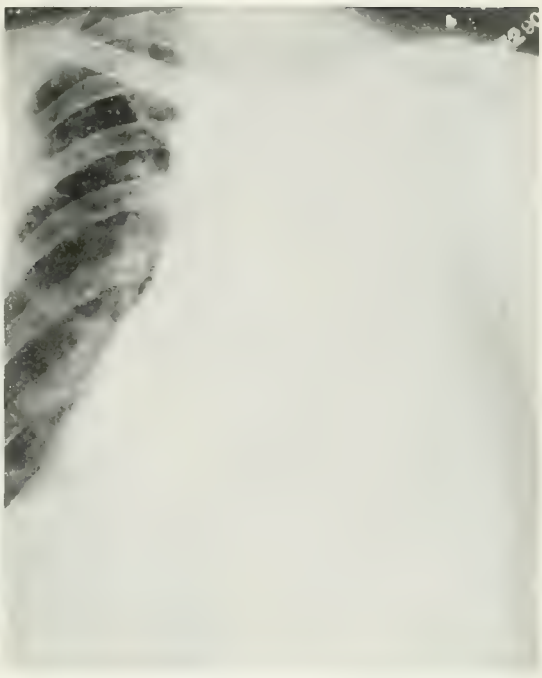

Fig. 2. Case 185290. Chest shown in Figure 1 following a Wilms' three-stage plastic operation. Complete obliteration of the cavity, April 7, 1920.

cases diagnosed tuberculous empyema he found the bacilli in only 5 (Sokottowski). In 6 cases there was no growth. He regarded the cases which were sterile to culture as tuberculous. Ehrlich found tuberculosis in 7 of 19 cases of empyema, Fraenkel found it in 1 of 12 cases, and Renvers in 2 of 15 cases. Netter writes that one always should obtain positive results in tuberculous empyema either by guinea-pig inoculation or by direct examination. Staphylococcus in pure culture is uncommon, but when present is suggestive of tuberculosis (Netter, Sokottowski). A sterile purulent effusion is tuberculous in the majority of cases (Sokottowski).

In chronic draining empyemata bacteriological study is of little value. Beck (6) reports staphylococci in practically all cases and streptococci in 10 per cent. Gordon, in an intensive study of 25 chronic cases, concludes that the primary organism, notably streptococcus, disappears, and that there may be a succession of secondary invaders. It seems evident, however, that, although a mixed infection always occurs in these drained cases, the tuberculous infection persists. Beck (3) states that tuberculosis is rarely found in secretions even in cases in which the empyema is positively of tuberculous origin, but that the bacilli may be demonstrated in numbers in the exudate after treatment with bismuth paste, which he believes stimulates leucocytosis, the leucocytes carrying the bacilli out in the discharge. Heuer refers to a case in which bismuth paste was used after which the exudate teemed with bacilli.

DIAGNOSIS

Positive proof of the tuberculous nature of a purulent exudate is afforded by finding the bacilli in the exudate by direct examination, by animal inoculation, or by a demonstration of the characteristic microscopic picture in the excised pleura. Unfortunately the demonstration of the bacilli in the exudate is usually difficult, and the animal inoculation

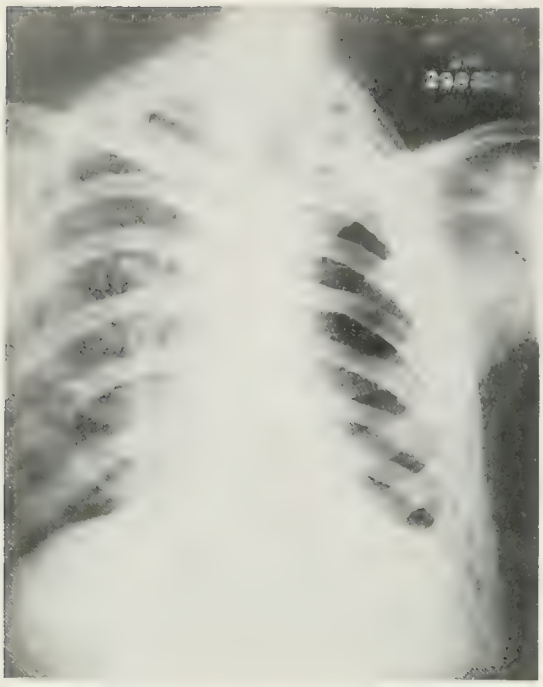

Fig. 3. Case 298385. Chronic empyema cavity of sixteen years' duration.

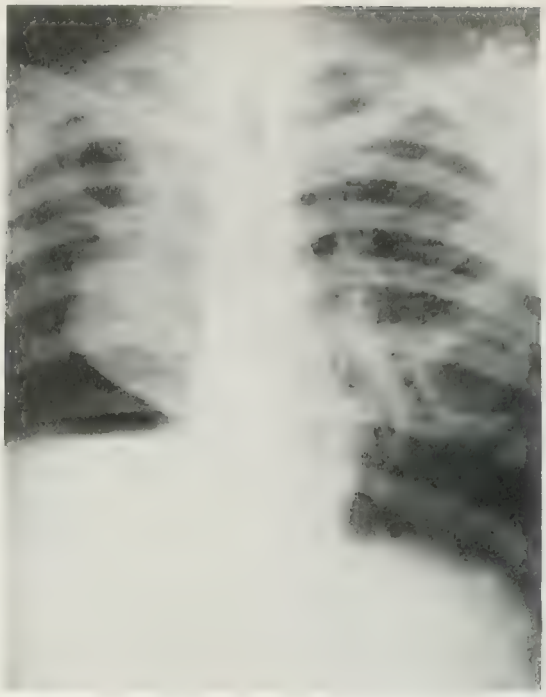

Fig. 4. Case 341738. Chronic tuberculous empyema cavity of two years' duration.

test results in many failures and requires at best 6 weeks of time. The examination of pleural tissue is a postoperative procedure. In the ordinary case, therefore, a presumptive diagnosis must be made on the clinical history of the case, the character of the exudate, and the recognition of a tuberculous process in some other organ.

History. A family history of tuberculosis is of some value. Cabot showed that in a series at the Massachusetts General Hospital of 300 patients with pleurisy, 67 per cent who later developed tuberculosis had a positive family history, while only 25 per cent of those who remained well had such a history. An insidious onset without preceding infectious disease, especially if accompanied with fever, night sweats, loss of weight and strength, loss of appetite, and progressively increasing nervousness, is always suggestive of tuberculous infection. The cases with insidious onset in apparently healthy, robust persons are among the most difficult to recognize. A history of preceding pleurisy with effusion, even though years before, affords grounds for suspicion that a later "idiopathic" empyema may be tuberculous. A history of pleurisy with serous effusion in an adult should be evaluated equally with that of an hæmoptysis (Lemon).

Character of exudate. In cases without drainage, sterile, purulent fluid, especially in the presence of fever and with a low leucocyte count, is almost certain to be tuberculous Staphylococcus infection, ordinarily rare in undrained empyema, has been found associated with tuberculosis. A pyogenic organism, notably pneumococcus, may die, but an effusion giving a negative culture and smear may be considered tuberculous.

The presence in other organs of a tuberculous lesion, notably pulmonary phthisis and tuberculous peritonitis, lends weight to a presumptive diagnosis of the tuberculous nature of co-existing empyema. A healed or quiescent pulmonary process such as is often seen in the roentgenogram is probably, taken by itself, of relatively little significance, but an

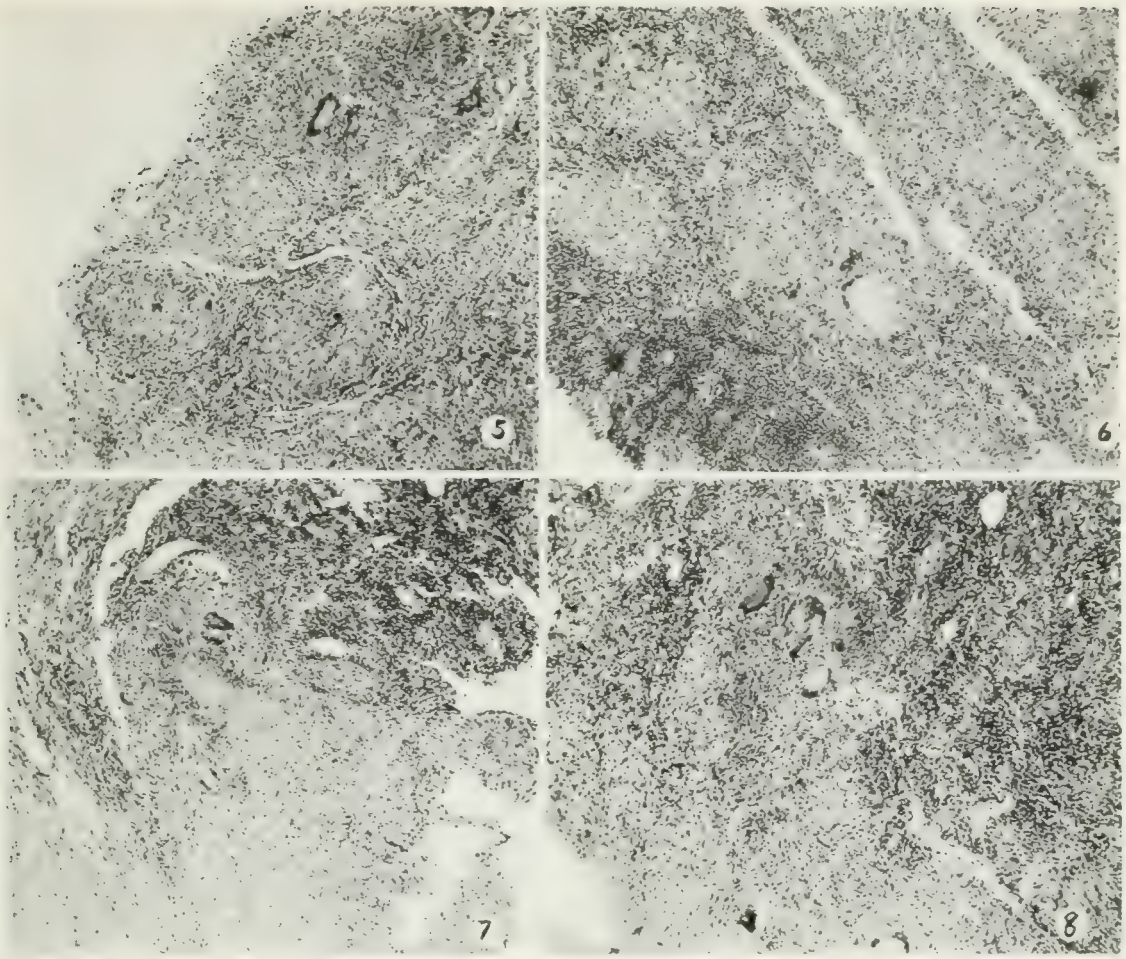

Fig. 5. Case 47717. Typical tubercles and foreign-body giant cells associated with marked lymphocytic infiltration in a tuberculous area in the parietal pleura.

Fig. 6. Case 185290. Ill defined tubercles and foreign-body giant cells associated with marked lymphocytic infiltration in a tuberculous area in the parietal pleura.

Fig. 7. Case 362614. Few foreign-body giant cells associated with marked necrosis, lymphocytic infiltration, and fibrosis in a tuberculous area in the parietal pleura.

Fig. 8. Case 289416. Ill defined tubercles and foreign-body giant cells in an area of tuberculous granulation tissue of the parietal pleura.

active process giving rise to characteristic râles, and especially positive sputum examination, leaves little room for doubt with regard to the tuberculous nature of an idiopathic purulent effusion. Effusion complicating artificial pneumothorax therapy, or following spontaneous pneumothorax in advanced cases, is probably tuberculous, even in the presence of pyogenic organisms, which in such cases contribute to a mixed infection. Fagiuoli reports serous effusion in 10 of 23 cases in which pneumothorax therapy was used.

MAYO CLINIC SERIES

The records of the Mayo Clinic since 1910 contain histories of 23 cases proved by bacteriological or pathological examination to be tuberculous empyema. These cases are included in Group 1. Fifty-one cases not so proved, in which a tuberculous lesion elsewhere, or other clinical features, make for at least a probable diagnosis of tuberculous empyema, have been classified into Groups 2, 3, and 4.

Group 1. In the 23 patients in this group the diagnosis was made or was confirmed by

examination of excised pleural tissue, in 18. Guinea-pig inoculation of the exudate was positive in one in the purulent stage and was positive in one in the serous stage; necropsy in the latter case showed pyopneumothorax, and tuberculosis of the lungs, liver, and retroperitoneal glands. Tuberculosis bacilli were found in smears of the purulent exudate in 3. Five patients had well-marked tuberculous lesions, associated with Pott's disease of the spine and multiple "cold" abscesses in one, tuberculous glands proved microscopically in one, and in one necropsy showed, besides, a large pulmonary cavitation, tuberculosis of the kidneys and multiple tuberculous ulcers of the intestines, from the perforation of one of which the patient had died. In the fourth the onset was that of a typical pleurisy with effusion, and in the fifth the sputum contained tuberculosis bacilli.

Group 2. In this group were 16 patients with clinically tuberculous empyema. Further evidence substantiated the presence of tuberculosis. In one patient (Case 51816), besides a history of pleurisy with effusion, chronic cough with sputum, and a diagnosis at operation, "cold" abscesses developed later in the chest wall. In 2 (Cases 137779 and 260196), characteristic lesions were found at necropsy, and in one besides cough, sputum, and physical signs of phthisis, hæmoptysis developed. In the remaining 12, various combinations of positive findings as to family history, past history of pleurisy, cough with sputum, physical and roentgen-ray findings, the gross appearance at operation, and the further course, leave little question of the presence of tuberculosis.

Group 3. There were 22 patients with empyema associated with pulmonary tuberculosis in this group. Roentgen ray showed the pulmonary lesion in all. In 3 there was an active process at the time of the first examination, and in 4 later examinations showed active progressive lesions. The bacilli were found in the sputum in 4 with active pulmonary foci, and in 1 without such foci. There was a positive family history in 2; in both the lesions were active. A history of pleurisy or "cold" preceding the empyema was noted in 6, and a past history of pleurisy was noted in 9, in 3 of which the immediate preceding illness was not characterized by pleurisy. The onset of the empyema was insidious in 3, and sudden in 14. The onset was preceded by pneumonia in 10. There were various combinations of cough with sputum and fever in 16, and there were râles or bronchial breathing, or both, in 6, in 2 of which there was no cough nor sputum.

Group 4. The patients in this group had empyema following idiopathic pleurisy with effusion. They gave histories of previous attacks which occurred within a year before the onset of the empyema in 5; in 3 it occurred 2, 3, and 9 years before respectively. The time was not stated in 4. Cough and sputum were present in 7 of the 13 patients. The sputum was examined for bacilli in 5, but none was found. Reports of the end-results concerning 8 of these patients have been received. Three died. One had a large pneumothorax, and one a persistent drainage and cough and sputum up to the time of death. The empyema was healed in 5.

Summarizing the diagnostic findings in the four groups, it may be said that in 23 patients the tuberculous nature of the empyema was proved. In 38 others the patient had a tuberculous infection, determined by pulmonary lesions, shown in the roentgenogram in 22, and by characteristic histories and symptoms in 16, in 7 of which the diagnosis of tuberculosis of the pleura was made at operation from gross appearance. Two of the remaining 9 patients died of tuberculosis. A presumptive diagnosis of tuberculous empyema was made in these 38 cases. A considerable proportion of the 13 cases in Group 4, in which there was a history of pleurisy with effusion, are probably cases of tuberculous empyema.

The question of the probability of empyema being tuberculous in the presence of a pulmonary lesion is one that cannot be answered categorically. Some writers are of the opinion that they are all cases of tuberculous empyema. The almost constant association of pleuritis, even with early localized pulmonary lesions, is a matter of common observation. It seems obvious that inasmuch as patients with tuberculosis of the lungs develop secondary pyogenic lesions, pneumonia, ab-

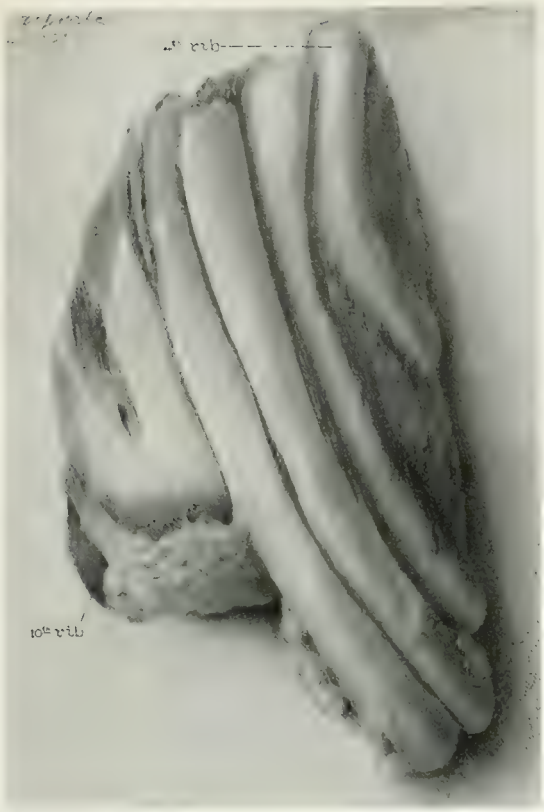

Fig. 9. Case 185290. Overriding and fusion of the ribs in tuberculous empyema of 22 years' duration.

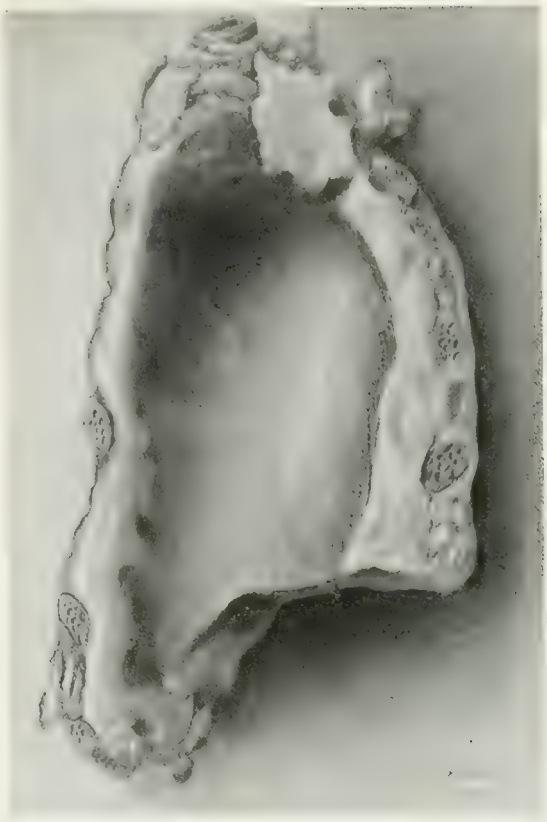

Fig. 10. Case 185290. Visceral aspect of specimen shown in Figure 9. Note thickness of parietal pleura.

scess, and so forth, they may also develop secondary pyogenic pleurisy. The difficulty of proving such cases to be tuberculous empyemata is analagous to the difficulty of establishing positive proof of incipient phthisis. Walton suggests that a distinction should be made between tuberculosis of the pleura, a secondary tuberculosis in a patient with chronic suppurating pleurisy, and suppurating pleurisy in a patient with tuberculosis. From a review of the literature it seems evident that the tuberculous nature of a large proportion of empyemata has remained unrecognized (Table I)

TABLE I.—RELATIVE INCIDENCE OF TUBERCULOUS EMPYEMATA REPORTED

Author	Cases	Diagnosis of tuberculosis	Percentage
Martin	21	3	14.2
Bergeat	21	4	19 0
Bythell	40	10	25 0
Wilensky	82	13	15 8
Moutard-Martin	84	7	8 3
Dunlop	98	3	3 0
Grieg	100	0	0 0
Netter (60)	109	12	11.0
Hirano	118	3	2 5
Voswinckel	129	14	10 0
Nathan	145	10	6 8
Holsti	166	12	7 8
Schede (68)	484	45	9.3
Hedblom	360	61	17.0

A more careful study of cases of chronic empyema in general, of cases in which there is a tuberculous focus, and of cases in which there is a history of a primary pleurisy with effusion, will undoubtedly prove a considerably larger proportion to be tuberculous.

TREATMENT

In the treatment of tuberculous effusion, account must be taken of its varied pathology and of the patient's condition. A distinction

GROUP I.— TUBERCULOUS EMPYEMA

Case	Sex and age	Pleurisy	Illness at onset	Onset sudden or insidious	Cough	*Bacillus tuberculosis* in sputum	Rales	Roentgen-ray findings	Previous operation	Diagnosis of tuberculosis	Operations	Pathological diagnosis	Remarks
47717	M 45	O	Influenza	S	+	+		Fluid	7 aspirations	O	2-18-19 Plastic, resection of three ribs, after Dakin's solution treatment. 5-2-19 Skin plastic	5-2-19 Tuberculosis of parietal pleura	2-20 Complete healing
51942	M 26	?	Pleurisy	S	+	+		Right tuberculosis, thickened pleura, left effusion	6-09 Drainage		6-10-11 Drainage (mixed tuberculous infection)		1914 Death. Empyema never healed; patient had pulmonary tuberculosis
101014	M 39	–	Pleurisy	S	-			Retraction	5 aspirations; rib resection	-	2-27-14 Partial Schede. 10-6-15 Skin plastic 6-29-17 Aspiration psoas abscess	6-17-16 Tuberculosis of parietal pleura	1-9-19 Death from influenza; no necropsy. Multiple "cold" abscesses; Pott's disease
107204	F 26	O	Pneumonia		+	+		Old tuberculosis; bronchial thickening	1914 Aspiration, tuberculous glands		8-21-17 Drainage		8-17 Death from septicæmia, no necropsy
111007	M 36	O	Abscess	S	+			Right empyema; thickened and retracted pleura	7-13 Rib resection	O	7-20-14 Drainage 4-24-15 Multiple rib resections 7-8-15 Minor Schede	7-2-15 Tuberculosis of parietal pleura	1917 Last report; good health slight drainage
111478	F 18	O	Pneumonia	S	+	+	+	Fluid; thickened pleura	5 aspirations	O	8-4-14 Rib resection for drainage 4-17-15 Incision for drainage 8-20-19 Exploration, no cavity found	4-17-15 Tuberculosis of parietal pleura	8-21 Wound still draining
116166	M 40	+	Pleurisy	S	+	+		Left empyema; thickened pleura	9-13 Rib resection	O	9-29-14 Drainage. 8-6-15 Schede operation 12-17-15 Rib fragment removed	12-17-15 Tuberculosis of parietal pleura	6-16 Wound almost healed, good health
130190	F 15	O	O	I	+			Empyema; thickened pleura, lung retracted	10-14 Aspiration; rib resection	+	6-9-16 Rib resection for drainage	3-30-16 Tuberculosis of parietal pleura 6-7-16 Tuberculosis of parietal pleura	S-17 Wound healed, no trouble since
149126	M 40	+	Pleurisy, grippe	I	+	+	+	Fluid, left lung collapsed, tuberculosis right	1914 12 aspirations	+	1-7-16 Rib resection for drainage	1-4-16 Tuberculosis bacilli in pleural exudate	7-16 Death
163057	M 44	O	Typhoid, pneumonia	S	O	+		Right empyema; large pocket	3 rib resections	O	6-30-16 Exploration after Dakin's solution treatment. 8-9-16 Schede	8-9-19 Tuberculosis of parietal pleura	9-10-19 Death; lung abscess, bronchial fistula, tuberculous empyema, tuberculous meningitis. No necropsy
185290	M 38	+	Pleurisy	S	O	O	?	Upper left tuberculosis; fluid	3-18 Drainage	+	8-12-19 Exploration and curettage, preliminary Dakin's solution treatment 3-16-20 Wilms first stage, after Dakin's solution treatment. 3-25-20 Wilms second stage 5-20-20 Wilms third stage	4-2-17 Tuberculosis by guinea-pig inoculation. 8-12-19 Tuberculosis of parietal pleura	3-21 Good health, slight drainage

217187	M 53	O	Cold	I	+		+	Tuberculosis both apices; fluid	Aspiration	+	12-24-17 Rib resection for drainage	12-17 Tuberculosis of parietal pleura	12-27-17 Death. Necropsy; perforation tuberculous ulcer of ileum; multiple tuberculous foci
230390	M 21	O	Cold	S	+	+		Fluid; heart enlarged		O	9 aspirations. 6-22-18 Rib resection for drainage; septic pyopneumothorax	6-24-18 Tuberculosis by guinea pig inoculation	6-28-18 Death. Necropsy; tuberculosis both lungs, liver, retroperitoneal glands
251743	M 22	O	Chill?		O		+	Lung retracted; right pneumothorax; fluid	3-17 Aspiration; drainage	O	12-12-18 Decortication after Dakin's solution treatment. 3-4-19 Rib resection for drainage Patient refused extensive plastic	3-4-19 Tuberculosis of parietal pleura	4-21 Wound still draining; treatment incomplete
260767	M 32	?	Lung abscess	I	+			Infiltration left lung	1913 Abscess left axilla	O	2-27-19 Exploration. 3-6-19 Negative aspiration. 3-30-19 Negative aspiration 7-17-19 Rib resection for drainage.	7-17-19 Tuberculosis of parietal pleura	Much improvement when last seen. Developed pulmonary tuberculosis, apparently as secondary complication
262614	F 27	+	Pleurisy; childbirth	I				Fluid	2 aspirations, rib resection	O	3-25-19 Decortication, after Dakin's solution treatment. 5-1-21 Rib resection and skin muscle plastic (bronchial fistula)	3-25-19 Tuberculosis of parietal pleura 5-1-21 Tuberculosis of parietal pleura	4-21 Wound practically healed
265092	F 21	+	Pleurisy; childbirth	I			+	Lung collapsed, probably fluid	2 aspirations, 12-18 drainage	O	3-27-19 Decortication, attempted. 11-19 Rib resection for drainage	12-19 Tuberculous sinus and pleura	12-19 Death from hæmorrhage
263570	M 27	+	Pleurisy	S	+	+		Probable empyema, left, tuberculosis; interlobar pleurisy right lung	6-18 drainage	O	3-18-19 Exploration after Dakin's solution treatment. 3-27-19 Rib resection and skin plastic	3-27-19 Tuberculosis of parietal pleura	5-20 Death
274687	M 54	+	Influenza	S	?			Pleural thickening, probably fluid	2-19 Drainage	O	6-28-19 Rib resection for drainage	6-28-19 Tuberculosis of parietal pleura	9-20 Slight drainage; patient working
280416	M 54	+	?	I	+	+		Left empyema; small pocket	1909, 11 aspirations, 1918 drainage	O	10-16-19 Decortication after Dakin's solution treatment 10-19-20 Rib resection and skin muscle plastic	10-19-20 Tuberculosis of parietal pleura	4-21 Wound healing; some pain
333166	M 29	+	Pleurisy; influenza		+	O	+	Pleurisy	12-19 Rib resection 2-20 Drainage	O	9-13-20 Aspiration, preliminary Dakin's solution treatment 10-4-20 Rib resection and skin muscle plastic	10-4-20 Tuberculosis of parietal pleura	10-10-20 Appendectomy; gangrenous appendix 5-21 Patient in sanitarium; drainage; high temperature, and so forth
333476	M 29	+	Influenza, pleurisy	I	O	+		Density; abscess	8-19 Rib resection	O	10-14-20 Decortication after Dakin's solution treatment 12-9-20 Rib resection and skin plastic	12-9-20 Tuberculosis of parietal pleura	5-21 Health good, wound healing slowly
340048	M 30	O	Influenza	I	+	+		Empyema; lung collapsed, fluid in right base	Aspiration; drainage; wound reopened	O	12-21-20 Rib resection and skin muscle plastic	12-21-20 Tuberculosis of parietal pleura	4-21 Narrow sinus, prognosis good

GROUP II.—CLINICALLY TUBERCULOUS EMPYEMA

Case	Sex and age	Pleurisy	Illness at onset	Onset sudden or insidious	Cough	*Bacillus tuberculosis* in sputum	Râles	Roentgen-ray findings	Previous operations	Operations	Pathological diagnosis	Remarks
22359	M 33	O	"Cold"	I	+	+	+	Right empyema; tuberculosis of left lung	1909 Aspiration	3-23-15 Rib resection for drainage		Patient left Clinic much improved Death reported
51816	M 39	+	Pleurisy	S	+	+		Old pleurisy		4-10-11 Rib resection for drainage. 12-12-11 Redrainage		Results unknown
121241	M 4	O	Pneumonia	S	+	+	+	Possibly fluid; tuberculosis both sides; thickened pleura		12-28-14 Rib resection for drainage		Death one week after discharge from Clinic
137779	M 42	O	"Cold"	I	+	+		Fluid; congestion	6-15 Negative aspiration	8-7-15 Drainage empyema necessitatis. 8-16-15 Drainage. 8-20-15 Redrainage	8-21-15 Chronic inflammation of pleuræ	8-28-15 Death. Necropsy; empyema; lung abscesses; perforation between bronchus and pleura
150774	F 22	O	Pneumonia	I			+	Thickened pleura	3 drainage operations	1-28-16 Drainage	1-28-16 Chronic inflammation of pleuræ	Intermittent drainage; patient's general health fair
155193	M 43	O		I				Calcified pleura		3-31-16 Drainage 10-20-16 Rib resection; redrainage; calcification of pleura	3-31-16 Inflammation of pleuræ	1917 Last report, draining
165322	F 57	+		S	+	+		Probable fluid	Aspiration	7-16 Three aspirations 7-31-16 Rib resection; drainage. 5-4-18 Exploration and redrainage		Last operation incomplete at patient's request. 3-21 Wound decreasing in size but not healed
167061	M 55	O	"Cold"	I	+	+		Fluid	6-16 Aspiration	7-28-16 Rib resection for drainage	7-20-16 Exudate negative	Death 2 weeks after discharge from the Clinic
260196	M 25	+	Pneumonia	I				Retracted ribs; thickened pleura	5 drainage operations	2-18-19 Rib resection; skin plastic 3-18-19 Skin plastic	3-18-19 Chronic inflammation of pleuræ	Wound completely healed; patient developed tuberculous meningitis. Death 4-20
264318	M 42	+	Pleurisy	I	O			Schede operation left; tuberculosis both apices	3 drainage operations	4-3-19 Exploration and drainage		8-8-19 Death
288515	F 31	+		I				Fluid, ribs resected	2 drainage operations	9-16-19 Aspirations, Dakin's solution treatment. 9-18-19 Exploration, drainage	9-18-19 Chronic inflammation of pleuræ	3-20 Sinus healed; good health since
292883	F 27	+		I	+	+	+	Old empyema; pneumothorax left lung thickened pleura; tuberculosis right	1917 Aspiration	10-14-19 Aspiration	10-14-19 Pleural exudate negative	Patient sent to sanitarium
298385	M 38	+	Pneumonia	S				Congestion left lung; pneumothorax right	Several aspirations. 1903 drainage	12-11-19 Exploration; Dakin's solution treatment		Patient too sick for radical operation, result not known
299285	M 26	+	Pleurisy	S	O	O		Pneumothorax	Several aspirations; 2 drainage operations	1-15-20 Rib resection and skin plastic. 11-9-20 Rib resection and skin plastic	1-15-20 Chronic inflammation of pleuræ	7-21 Good health; wound healing rapidly
300041	M 66			I	+	+		Fluid left, old empyema right; calcified tuberculous pleurisy left		12-24-19 Aspiration	12-19-19 Pleural exudate negative	3-21 Reaccumulation of fluid; further operation not advisable
302859	M 58	+	Pneumonia	S	+	+	+	Old empyema, right; large pocket	1912 Aspiration; drainage	1-27-20 Rib resection, drainage 3-9-20 Rib resection and skin plastic bronchial fistula)	1-27-20 Chronic inflammation of pleuræ	1-21 Wound healed; patient working and in good health

must first be made between effusion in a closed pleural cavity and one in an open cavity. The exudate in a closed cavity may be sterile or secondarily infected; that in an open cavity is always secondarily infected.

Pleural effusion in a closed cavity. A sterile effusion in a closed cavity may be serous, hæmorrhagic, or purulent. The presence of enough exudate to be clearly recognized clinically is usually considered as an indication for aspirating as much of the fluid as can be obtained. Certainly enough fluid to produce symptoms of mechanical embarrassment to respiration and circulation is generally considered a clear indication for the aspiration of large amounts of fluid. Evidence has been brought forward, however, to show that a sterile exudate exerts a healing effect in a tuberculous process in the lung. Koeniger reports 78 cases in which marked improvement occurred in all but 3 per cent, and the improvement seemed lasting in more than half. Similar observations have been reported by Mongour, Schroeder, Kaufmann, Muralt, and others. Spengler and Sauerbruch point out that this does not seem to be due to the mechanical compression of the lung because the improvement observed is not in proportion to the amount of exudate and consequent compression of the lung. They believe the result to be due to a biological process of great importance. Koeniger attributes the improvement to a chemic process inducing auto-immunization.

On a somewhat similar basis, Gilbert proposed injecting some of the aspirated fluid subcutaneously. Others have since advocated the treatment. Fishberg reports 14 cases, in 11 of which treatment was beneficial, and Lyter reports 23 cases with favorable results in 8. When it is considered, however, that the exudate probably contains living tuberculosis bacilli, the rationale of such treatment seems questionable.

From the foregoing it appears very doubtful if it is ever advisable to remove large amounts of fluid at one time. Aside from a possible biological influence exerted by the fluid, its aspiration may exert an unfavorable influence on a co-existing incipient or active pulmonary lesion. Spengler states that miliary tuberculosis has been known to follow. Clinical experience has also shown that, whereas aspirating a large amount of fluid seems to stimulate further exudation, the aspiration of a relatively small amount results in an augmented rate of spontaneous absorption.

In order to prevent re-expansion of a tuberculous lung, whether by aspiration or rapid spontaneous absorption of the fluid, nitrogen or filtered air may be injected to replace all or a part of the volume of the fluid removed Such treatment is especially indicated in case effusion follows artificial pneumothorax therapy.

Patients with sterile purulent exudate are of the type most liable to become the victims of injudicious surgery. This condition represents an exception to the rule *ubi pus ibi evacue* for the simple reason that there is no pus in the sense of the word used in this hackneyed phrase. A sterile, purulent exudate presents essentially the same condition as a serous exudate, and should be treated on the same principles. In many cases in which there are considerable amounts of purulent exudate in the pleural cavity, remarkably little evidence of its presence is shown. Baeumler reports the case of a young girl who remained well nourished, free from fever, and who worked regularly for 3 years, although from 1000 to 1700 cubic centimeters of pus were aspirated at intervals. Such patients should not be aspirated indefinitely, however, but an extrapleural plastic operation should be performed. Aside from the danger of a mixed infection, either introduced during repeated aspiration or a concurrent infection elsewhere metastasizing to the pleura, there is probably in most cases a marked and progressive thickening of the diseased pleura, making the collapse of the cavity by an extrapleural plastic operation more difficult.

A mixed tuberculous and pyogenic infection in a closed cavity, especially with marked sepsis, requires prompt drainage, either by the open or by the closed method, with antiseptic solution drainage. Sterilization by the antiseptic irrigation of the closed cavity has the distinct advantage that the cavity may be considerably reduced in size, and a later

GROUP III.—EMPYEMA ASSOCIATED WITH PULMONARY TUBERCULOSIS

Case	Sex and age	Pleurisy	Illness at onset	Onset sudden or insidious	Cough	*Bacillus tuberculosis* in sputum	Râles	Roentgen-ray findings	Previous operations	Operations	Pathological diagnosis	Remarks
40116	M 21	O	Pneumonia	S	+	+		Tuberculosis?		8-2-10 Drainage		Empyema healed in 1910. Severe chronic nephritis
47069	M 56	+			+			Tuberculosis opposite side	Aspiration	6-30-11 Rib resection; drainage		Wound had completely healed; patient's general condition much improved at last report. Death, cause unknown
70209	F 20	+	Pleurisy	S		+	+	Probable fluid; thickened pleura; tuberculosis left lung	Aspiration negative	7-29-12 Rib resection for drainage	7-10-12 Pleural exudate negative	Sinus healed once; reopened during pregnancy 1916. Last report very poor condition
73093	M 19	O	"Cold"	S	+		+	Compression and empyema with cavity, left lung; tuberculosis both upper lobes	Aspiration	9-18-12 Rib resection for drainage	9-3-12 Mixed infection in pleural exudate	1-16 Death
73419	M 18	O	Pneumonia	S				Fluid left lung, thickened pleura tuberculosis both upper lobes	9-16 Drainage	9-16-12 Rib resection; drainage. 11-27-12 Decortication		Wound completely healed; general condition good
85430	M 13	+	Pleurisy	S	+	+		Empyema right; tuberculosis right upper lobe		7-14-13 Rib resection for drainage 1-19-14 Redrainage		Health excellent, wound healed soon after second operation
87487	M 42	O	Pneumonia	I	+	+		Abscess left lung; tuberculosis left lung		7-15-13 Rib resection for drainage		Following operation the patient developed paraplegia of legs. Death within a year
87538	M 46	O	"Cold"	I	+	+	+	Old tuberculosis and marked density left lung		7-18-13 Rib resection for drainage (calcareous pleura)		Operation elsewhere for abscess formation Death 1914
120182	M 19	O	Scarlet fever	S	+	+		Thickened and retracted pleura; tuberculosis left lung; old empyema right	1-14 Drainage	12-11-14 Drainage 3-16-15 Rib resection and skin muscle plastic		Condition fair, permanent healing not secured
123274	M 18	O	Typhoid	I	+			Tuberculosis ? left lung; old empyema right	10-14 Drainage; 11-14 Aspiration	2-3-15 Rib resection and skin muscle plastic		Complete cure
158179	M 63	O	Trauma		+	+		Calcified tuberculous pleura left; fibrosis	6-16 Drainage	5-2-16 Drainage	6-6-16 Guinea pig inoculation negative	Healing not secured; condition fair
165708	M 57		Pneumonia	S	+	+	+	Old empyema with collapsed lung left healed tuberculosis right lung	1904 Drainage	7-17-16 Drainage	7-17-16 Chronic inflammation of pleurae	1920 Death
198262	M 53	+	"Cold"	I	+			Empyema with retracted lung, left; tuberculosis? right lung	6-15 Drainage	6-25-17 Rib resection; drainage		Results unknown
210210	M 28	O	Gangrenous appendix and subphrenic abscess				+	Fluid, retracted lung and pneumothorax right; tuberculosis right lung	4-15 Gangrenous appendix	10-11-17 Rib resection; drainage. 11-9-20 Exploration. 12-16-20 Rib resection and skin plastic	10-11-17 Chronic inflammation of pleurae	2-26-20 Death. Immediate cause cardiac failure

276042	M 33	O	Influenza	?			Effusion and thickened pleura left; healed tuberculosis right	10 18 Aspiration 11 18 Drainage	7 1-19 Rib resection and skin muscle plastic	7 1-19 Chronic inflammation of pleura		Complete cure
277547	M 31	O	Influenza	?	+	+	Thickened pleura and fluid; tuberculosis left lung		7 1-19 Rib resection; drainage 9 29 19 Exploration and Dakin's solution treatment	7 1-19 Chronic inflammation of pleura		Complete cure
284600	M 23	+	Pneumonia	?	+	+	Thickened pleura, healed tuberculosis both lungs	6 18 Drainage, 11 18 Drainage	8 16-19 Exploration and Dakin's solution treatment. 11 4 19 Drainage	11 1-19 Chronic inflammation of pleura		Cavity still draining; plastic operation probably indicated
296755	M 25	O	Pneumonia	?	+		Thickened pleura	8 17 Drainage	10 2 19 Exploration and Dakin's solution treatment 10 14 19 Drainage			Wound completely healed
301068	M 37		Pneumonia		+		Tuberculosis of left lung, effusion	8 18 Drainage	9 21 20 Exploration and Dakin's solution treatment 9 4 20 Rib resection and drainage			Steady improvement
324812	M 18	+	Influenza; pneumonia	?	+	+	Fluid right, tuberculosis both lungs	8 20 Aspiration	7 24 20 Exploration and Dakin's solution treatment 11 19 20 Exploration, drainage			Patient convalescing
341788	M 18	+	Influenza; pneumonia	?	+	-	Lung collapsed left tuberculosis with cavity right lung	8 aspirations	11 27 20 Aspirations	11 28 20 Pleural exudate negative		Patient to return for probable plastic
341011	M 27	+	Pneumonia; pleurisy	?	+	+	Thickened pleura; tuberculosis with cavity, left lung, collapsed right lung	Aspiration and 3 drainage operations	12 4 20 Exploration			Improved; patient to return for a decortication

extrapleural plastic operation may be performed if a cavity persists. The use of an irritating, and especially of a corroding, fluid, such as Dakin's solution, is, however, contra-indicated in any case of well-marked pulmonary lesion, because of the tendency to bronchial fistula and hæmorrhage from the action of the fluid on the exposed diseased area of the parenchyma of the lung.

In mild, secondary infections such as pneumococcus, it may be possible to treat the case as one of sterile effusion. Spengler recommends irrigation of the pleural cavity with salt solution, 0.5 per cent lysol solution, or a weak solution of iodine and potassium iodide. Jacobaeus recommends repeated aspiration in cases of open pleural cavities, with a view to promoting healing of the drainage opening.

Tuberculous exudate in an open pleural cavity. The opening into the pleural cavity in such cases may be through the chest wall, due to a drainage operation, or to spontaneous perforation of an empyema necessitatis, or into a bronchus due to a ruptured tuberculous cavitation producing spontaneous pneumothorax. These all result in mixed infection.

Cavities following drainage operations vary from those in which there is only a residual tubular or sinus tract to those in which the entire pleural cavity is involved. With cavities of long duration the pleura is usually thickened. Antiseptic solution irrigation in such cases is not only safe, but usually is followed by marked improvement in the patient's general condition. There may be very little thickening of the pleura, however, as in several cases in this series. In one of these, symptoms developed suggesting small bronchial fistulæ and a lighting up of a tuberculous lesion.

The hypochlorite solution seems to have little or no influence on the tuberculosis bacillus in these cases. Scholl observed a case at the Rockefeller War Demonstration hospital in 1917 in which an empyema cavity of about 500 cubic centimeters capacity was treated with 100 cubic centimeters Dakin's solution every 2 hours for 10 days. Cultures for tuberculosis at the end of that time were positive, showing that the solution did not kill the bacilli.

GROUP IV.—EMPYEMA FOLLOWING IDIOPATHIC PLEURISY WITH EFFUSION

Case	Sex and age	Pleurisy	Illness at onset	Onset sudden or insidious	Cough	*Bacillus tuberculosis* in sputum	Râles	Roentgen ray findings	Previous operations	Operations	Pathological diagnosis	Remarks
57110	M 31	+	Pleurisy	I	+	+			8 aspirations	8-20-10 Drainage		Death
59027	F 25	+	Pleurisy	S			+		3 aspirations	1-7-7-10 Drainage		Result unknown
40960	M 52	+	Pleurisy	S	+	+				8-3-10 Rib resection, drainage	8-3-10 Pleural exudate not tuberculous	Result unknown
42602	M 4	+	Pleurisy and pneumonia	S					Drainage	9-3-10 Rib resection, drainage		Result unknown
61808	M 20	+	Pleurisy	S	O			Fluid right	Drainage	12-7-11 Drainage 1-17-13 Redrainage		1913 Wound healed, patient in good health
61968	M 43	+	Pleurisy and pneumonia	S	+	+			2 aspirations	12-9-11 Drainage. 1-3-12 Redrainage. 9-21-12 Redrainage		Cure
117738	M 53	+	Pleurisy	I	+	+		Thickened and retracted pleura; drainage in superficial pocket; old empyema left	1 aspirations. 3 drainages	12-30-13 Schede, partial decortication		1913 Death, probably from pneumonia, patient had been doing very well
141027	M 24	+	Pleurisy	I	O	O		Old empyema right	9-11 Drainage	9-2-16 Rib resection and skin muscle plastic 6-27-16 Drainage. 8-30-17 Second skin muscle plastic	6-2-16 Chronic inflammation of pleura	1919 General health excellent, complete cure
150376	M 31	+	Pleurisy	I	+	O		Left lung collapsed	10 aspirations, 2 drainages	9-29-16 Drainage 8-31-18 Exploration and drainage		9-29-18 Death
174822	M 19	+	Pleurisy	I		+	+	Fluid right lung	10-16 Aspiration	10-11-16 Rib resection for drainage. 11-2-16 Redrainage 11-29-16 Redrainage. 12-11-16 Rib resection for redrainage		Complete cure, general health excellent
17221	M 31	+	Pleurisy	S	O		+	Pleura thickening, pocket base right lung	Aspiration, 2 drainage operations	2-16-18 Rib resection; drainage		Result unknown
280109	M 31	+	Pleurisy	S				Retraction, right lung; small pneumothorax	3 drainage operations	1-13-20 Skin plastic and Ransohoff. 5-21-20 Skin plastic (bronchial fistulæ). 5-27-20 Small skin plastic	1-13-20 Chronic inflammation of pleuræ	Complete cure, general health very good
342884	F 20	+	Pleurisy; "cold"	I	+	O		Old empyema; lung collapsed, right	6-20 Thoracotomy	12-20-20 Rib resection for drainage		Patient convalescent at last report

Small cavities and sinuses seem to constitute favorable cases for the use of bismuth paste. Beck (5) reports a cure in about 80 per cent of 150 cases of chronic empyema, but he does not state what proportion of these cases was tuberculous. Heuer reports one case in which complete sterilization of a cavity resulted from the use of the paste, so that it was closed as a sterile pneumothorax, but in the case of another cavity the treatment failed.

Cases of impending empyema necessitatis require preliminary open drainage, as a sinus forms if an attempt is made to use the closed method. These cases, often of long standing, as a rule require later plastic operation.

Tuberculous empyema with large bronchial fistula due to rupture of a cavitation into the pleura may result in a virulent secondary infection and require prompt drainage, usually by wide incision, as irrigation with antiseptics is impossible. The immediate mortality in these cases is high. Often patients who survive require later plastic operation. Forlanini had 8 patients; all died. Sauerbruch reports 73 cases, 57 following pneumothorax therapy, 16 spontaneous. Fifty-three patients died, most of them soon after drainage operation.

TYPES OF OPERATIONS FOR CHRONIC TUBERCULOUS EMPYEMATA

Drainage operation. It cannot be overemphasized that the open drainage operation is contra-indicated in cases of sterile tuberculous empyema. It will do no good, and is sure to do harm, by introducing a secondary infection. Withdrawal of a part of the fluid by aspiration is indicated in such cases only if the fluid gives rise to mechanical embarrassment. In 41 patients in this series, drainage had been established elsewhere, and the cavities were, therefore, secondarily infected. Of the 35 patients who had not had drainage 5 belonged to Group 1, in which an absolute diagnosis of tuberculous empyema was made. One of the patients (Case 101014) developed mixed infection following sudden pneumothorax after having been aspirated several times for serous effusion which contained the bacilli. He died shortly after rib resection. One patient (Case 107204) died of septicæmia 6 days after rib resection. One patient (Case 217107) presented himself with symptoms of an overwhelming infection. He died 3 days after rib resection for drainage. Necropsy showed extensive tuberculous lesions and the immediate cause of death to be a perforated tuberculous ulcer of the ileum. In the smear made from one patient (Case 149126), the bacilli were found. A rib was resected for drainage. He died 6 months after operation. The fifth patient had a large seropurulent effusion following exploration for lung abscess. Later examination of the excised pleural tissue showed tuberculosis. The roentgen ray showed a wide-spread tuberculous lesion; the sputum was positive for acid-fast organisms. The empyema cavity healed, and the patient improved remarkably and remained quite well during a period of observation extending over several months.

In 7 of the 16 patients in Group 2 with clinical diagnoses of tuberculous empyema, drainage had been instituted elsewhere. On 6 of the remaining 9 rib resections had been performed for drainage, on 3 (Cases 22359, 51816 and 137779) on account of pyopneumothorax with bronchial fistulæ with associated symptoms of mixed infection. One of these patients (Case 137779) also had an impending perforation of empyema necessitatis. Two other patients had large amounts of sputum with marked symptoms of sepsis suggesting possible perforation into a bronchus. One of these two also had an impending empyema necessitatis. A sixth patient had three aspirations followed by prompt reaccumulation of pus. She was considered in too poor condition for a radical plastic operation. A simple drainage operation was performed at the patient's request, and with a view to later plastic operation. Two patients were treated by aspiration only. In one (Case 292083) the pus was sterile and the cavity small. The patient was sent back to the tuberculosis sanitarium from which she came; she died a few months later. The other (Case 300040) was aspirated and the pus was found to be sterile. He did not wish a plastic operation until after trying repeated

aspiration. He was, therefore, recommended to a tuberculosis sanitarium.

Ten of the 22 patients with pulmonary tuberculosis and an associated empyema had had previous drainage operations elsewhere. Of the remaining 12, all except 2 had rib resection as the primary operation. Pulmonary tuberculosis was present in all of these, but the general characteristics of the empyema were of the ordinary type. In 3, repeated aspiration of pus was done, and the culture showed a mixed infection. Cough with a large amount of sputum was present in 2, indicating a bronchial fistula. The other patients appeared to have ordinary empyema. In 1 of these no pus was found, but an empty cavity lined with calcareous deposit.

In Group 4, patients in whom empyema was preceded by idiopathic pleurisy, drainage operation had been performed on 8. Rib resection was performed on the other 5.

The closed method in cases of draining cavities secondarily infected is of great advantage if antiseptic solutions can be used. The Dakin's solution treatment was used for 10 patients in the first group before the diagnosis had been established. A small bronchial fistula developed in one case during the treatment, but it was not of sufficient size to make it necessary to interrupt the treatment. In one case after a few irrigations it became impossible to use the fluid on account of coughing during which the patient tasted the fluid. He developed fever and increased sputum following the treatment, and lost weight. The treatment was therefore interrupted. This case is an example of a type in which there is only partial incapacity from the presence of the tuberculous empyema, and in which it is questionable if an extensive radical operation should ever be urged. The patient declined to have a Wilms operation at the time. The antiseptic solution was relatively harmless in this case, and of great advantage in all of the other cases, since the symptoms referable to septic absorption were distinctly ameliorated.

Decortication of the lung by the Delorme-Fowler method. It seems questionable whether this operation is ever indicated in the presence of an extensive or active phthisis. In such cases fibrosis limiting the expansibility of the lung and the danger of lighting up a latent focus must always be considered. In other cases, without a demonstrable pulmonary lesion, it is impossible to separate the thickened membrane from the lung. Delorme writes that tuberculous empyema is not a contra-indication to the operation. The most favorable report found in the literature is by Violet, who reported 17 cases in which the operation succeeded in 10 and failed in 7. Tuffier states that cases in which it is difficult or impossible to liberate the lung are as a rule tuberculous.

In the present series of 74 cases decortication was attempted in 6, in all before the tuberculous nature of the empyema had been recognized. These cases have been reported elsewhere (33). In 5 the cavity seemed materially reduced at the later operation, but it is questionable whether sufficiently so to warrant the operation. In all these cases a later plastic operation was required. In one of these (Group 1, Case 263092) in which there was no demonstrable lesion in the lung the pleura was only very little thickened, but the surface of the lung was very irregular and corrugated, making decortication impossible, although the lung was freed up en masse. In one case (Group 1, Case 289416), the surface was smooth, but the pleura was thickened over the upper portion of the lung only, thinning down to normal proportions toward the base. In the other cases there was nothing about the appearance of the pleura to suggest the tuberculous condition shown by microscopic examination. In one case (Group 3, Case 73419) the cavity was completely obliterated.

Plastic operations. The Estlander extrapleural rib resection, complete resection of the whole thickness of the chest wall with the use of a skin flap (Beck, 4) a skin muscle flap following a similar resection (Robinson), extensive radical resection (Schede, 67), and the extrapleural two-stage or three-stage rib resection of Wilms have all been used with success in the treatment of tuberculous empyema. Beck's operation, which is similar in principle to the Schede operation, lends itself well to the treatment of relatively small

residual cavities following rib resection for drainage. For large infected cavities the Schede operation best meets the anatomic indications, but the mortality of the one-stage operation has been as high as from 70 to 80 per cent (Spengler and Sauerbruch, Wilms).

In cases with cavities of large size, often with an associated pulmonary lesion and usually with marked debility, a several-stage extrapleural rib resection not only gives a low mortality, but offers good prospect of cure. This operation is an outgrowth of an attempt to modify the Estlander operation. Jaboulay and Lemaire, instead of performing an Estlander resection of the ribs over the whole extent of the cavity, simply cut the ribs on the sternal border; Boiffin sectioned them at the vertebral border of the cavity. Tietze later combined the two methods and Wilms modified it by resecting segments several centimeters long, chiefly posteriorly but also anteriorly, if necessary, and dividing the operation into two or three stages. Freidrick proposed to call the procedure the Boiffin-Wilms operation. Wilms calls it the Pfeiler resection, and first used the method for collapsing the chest wall in cases of uncomplicated pulmonary tuberculosis. Kolb and later, Wilms, and others, applied the method to tuberculous empyema.

Wilms recommends resecting 10 or 15 centimeters of the sixth to the eleventh ribs posteriorly at the first operation, and 8 to 10 centimeters of the fifth to the second or first ribs, with suturing of the wound at a second operation. This permits the entire chest wall to sink in, the elasticity of the sternal ends of the ribs allowing considerable mobility. Only if further collapse is necessary are the sternal ends of the ribs sectioned. If a cavity still persists a flap can be turned back and the rib segments and the portion of the pleura overlying it can be excised. The operation can be performed under local anæsthesia; it results in but slight trauma to the tissues; the posterior incision is a safe approach to the second and to the first ribs. The operation in stages and the freedom from infection in the wounds make it relatively safe for very poor surgical risks. The advantages of the operation are almost equally great in cases in which there is mixed or secondary infection but in these there is a characteristic tendency to a persistent sinus. Wilms reports 12 cases without mortality, and other successful cases following this operation are reported by Linderstroem.

In the series of 74 cases plastic operations were performed in 12 cases in Group 1, in 3 cases in Group 2, in 4 cases in Group 3, and in 3 cases in Group 4. In Group 1, Beck's operation was performed as a preliminary operation in 3, and as a secondary operation in 9. An operation of the Schede type was performed in 5, in 1 for a draining empyema of 22 years' duration, and a Wilms operation in three stages was performed in 1. That a Schede operation is the only operation that will obliterate the cavity in some instances was obvious in the case of the empyema of 2 years' standing. The ribs were overriding and so much thickened that it was impossible to separate them for resection. The pleura, moreover, was fully 2.5 centimeters thick and very rigid. In such a case very little would probably be gained by any procedure that would not include eventually a complete resection of the enormously thickened, chronically diseased chest wall.

Resection of the scapula is sometimes desirable in plastic operations. Hellstroem believes that it should be performed in all cases.

RESULTS OF TREATMENT

The type and sequence of the operative treatment at the Mayo Clinic is indicated in Tables II and III. In these tables insertion of a tube for aspiration and Dakin's solution irrigation is listed as aspiration. Drainage operations were, for the most part, rib resections. It will be noted that the decortication was performed with one exception as a primary operation. In these cases the diagnosis of the tuberculous nature of the empyema was made from the excised pleura. Plastic resections were, as a rule, secondary procedures. The results grouped according to the operations are shown in Table IV.

The patients who had several operations are grouped under the heading of the last operation or under the operation which is judged to have contributed most to the result

TABLE II.—TYPES OF OPERATION (MAYO CLINIC SERIES)

	Aspiration	Exploration	Drainage	Decortication	Skin plastic	Skin muscle plastic	Schede operation	Wilms operation	Total
Group 1	13	5	16	5	5	4	4	3	55
Group 2	6	4	13		5				28
Group 3	1	8	18	1	1	3			32
Group 4		1	17		3	2	1		24
Total	20	18	64	6	14	9	5	3	139

TABLE III.—SEQUENCE OF OPERATIVE PROCEDURE (MAYO CLINIC SERIES)

Type of operation	First operation	Second operation	Third operation	Fourth operation	Total
Aspiration	17	1	2		20
Exploration	11	5	2		18
Drainage	41	17	4	2	64
Decortication	5	1			6
Skin plastic	4	8	2		14
Skin muscle plastic	4	4	1		9
Schede	2	2	1		5
Wilms		1	1	1	3
Total	84	39	13	3	139

obtained. It will be noted that the largest proportion of cures followed plastic operations. In the group in which a drainage operation only was performed, the high mortality is due to the relatively poor condition of these patients.

The results are grouped according to the pathological subdivisions in Table V. It will be noted from this table that of 67 patients in whom the end-results are known, about 58.2 per cent were cured, or much improved, 4.5 per cent were not improved, and 37.3 per cent died. The postoperative mortality, deaths within 2 months of operation, was 14.9 per cent.

Of the patients in Group 1, definitely proved to be tuberculous, 61 per cent were cured, or greatly improved; 39 per cent died. The postoperative mortality was 21.7 per cent. In Group 2, patients with clinically tuberculous empyema, the results are known concerning 14; 50 per cent were cured or much improved and 50 per cent died. The operative mortality was 21.4 per cent. In Group 3, patients with empyema associated with pulmonary tuberculosis, 57.1 per cent were cured or much improved, 14.3 per cent not improved, and 28.6 per cent died. The postoperative mortality was 4.7 per cent. In Group 4, patients with empyema following pleurisy with effusion, 66.6 per cent were cured or improved; 33.3 per cent died. The postoperative mortality was 11 per cent.

SUMMARY

1. Primary or idiopathic pleurisy with effusion, in a large proportion of cases, is probably tuberculous in nature.

2. A past history of pleurisy with effusion is common in cases of tuberculous empyema. In many cases the effusion is serous at the onset.

3. Tuberculous pleurisy may be primary, or it may be secondary to a pulmonary, peritoneal, or other tuberculous lesion.

4. The onset of a tuberculous effusion may be insidious or it may be sudden and associated with an acute and severe constitutional reaction. A mixed pleural infection due to the perforation of a tuberculous cavitation often runs an acute and rapidly fatal course.

5. Diagnosis of tuberculous empyema is made by demonstration of the bacilli in the

TABLE IV.—RESULTS BY OPERATION

Operation	Cure	Good health, sinus	Improvement	No improvement	Operative death	Death later	Total deaths	Unknown	Total
Aspiration			1	1		1	1		3
Exploration					1	1	2	1	3
Drainage	9	5	8	2	7	9	16	6	46
Decortication	1								1
Skin plastic	3	2			1	3	4		9
Skin muscle plastic	3	2	3						8
Schede		1			1	1	2		3
Wilms		1							1
Total	16	11	12	3	10	15	25	7	74

TABLE V.—RESULTS BY GROUPS

	Cure	Good health, sinus	Improvement	No improvement	Operative death	Death later	Total deaths	Unknown	Total
Group 1	2	7	5		5	4	9		23
Group 2	2	3	2		3	4	7	2	16
Group 3	7	1	4	3	1	5	6	1	22
Group 4	5		1		1	2	3	4	13
Total	16	11	12	3	10	15	25	7	74

exudate, by animal inoculation, or by examination of the sectioned pleura.

6. A sterile effusion is probably tuberculous. An infected effusion may be tuberculous.

7. Empyema following primary idiopathic pleurisy with effusion, or empyema of insidious onset, especially in the presence of a pulmonary or other tuberculous condition, is probably tuberculous.

8. Empyema may be tuberculous in spite of persistently negative findings over a long period of time.

9. In a closed pleural cavity a sterile effusion, whether serous or purulent, should not be treated by open drainage, except in the presence of an impending perforation of the chest wall.

10. Repeated aspiration of only part of the fluid present is indicated in cases of serous effusion producing definite dyspnœa on exertion or symptoms of circulatory embarrassment.

11. The replacing of aspirated fluid by nitrogen or filtered air may be indicated in cases in which there are symptoms of active phthisis referable to the same side as the effusion.

12. A sterile purulent effusion should be treated as though it were serous if the lung expands when fluid is withdrawn. If the lung is fixed in a collapsed condition or if the effusion persistently recurs, an extrapleural plastic operation is indicated.

13. Effusion in a closed cavity showing a mixed infection should be treated by the closed method with antiseptic solution irrigation, or by open drainage; the open drainage is indicated especially in cases of severe infection associated with extensive pulmonary tuberculosis, making irrigation hazardous.

14. Tuberculous empyema with a large bronchial fistula should be drained by the open method.

15. A large tuberculous empyema with mixed infection from a previous drainage operation or from spontaneous perforation of the chest wall requires a plastic operation, preferably after treatment with Dakin's solution.

16. A plastic operation involving closure of a bronchus offers the only prospect of

cure in case of an associated large bronchial fistula.

17. Dakin's solution irrigation may be contra-indicated in the presence of an extensively diseased lung, owing to its corroding action on any superficial lesion, possibly resulting in hæmorrhage or the formation of a bronchial fistula.

18. A plastic operation is usually eventually required in the case of closed cavities when the empyema is of long standing, and of all large, open, secondarily infected cavities.

19. An extrapleural rib resection is indicated for the collapse of closed sterile cavities. The Boiffin-Wilms operation is especially suitable for the collapse of large cavities without excessive thickening of the parietal pleura or rib deformity.

20. A skin or skin muscle plastic is indicated for the obliteration of relatively small cavities. Cases of long standing associated with greatly thickened pleura require an extensive resection of the entire chest wall after the method of Schede.

21. Operation in several stages is especially indicated in the treatment of tuberculous empyema, and, if practicable, it should be preceded by antiseptic solution irrigation. Such treatment should extend the indications for operation and should lower the postoperative mortality.

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GASTRIC HÆMORRHAGE[1]

BY GEORGE E. ARMSTRONG, M.D., F.A.C.S., MONTREAL, CANADA

MASSIVE hæmorrhages from the stomach occur under different conditions. It is not my purpose to refer to those following operation upon the stomach or to those due to leukæmia, ruptured aneurism, hepatic cirrhosis, and ruptured œsophageal veins, or eroded artery.

There is a group of cases in which massive hæmorrhages take place into the stomach and in which, as far as I know neither the surgeon, the pathologist, the bacteriologist nor the physiologist have as yet offered a satisfactory explanation for the occurrence. The bleeding tends to recur at short intervals until the patient dies. We have had ten or a dozen such cases in Montreal during the past 12 years. They resemble each other very closely. The bleeding comes on suddenly, without any warning and without any recognizable, predisposing, or immediate cause. The patients at the time are in their usual health and not guilty of any notable indiscretion.

Perhaps the report of one such case may serve as an illustration.

A. L., age 33, a well-nourished, active, railroad man, a civil engineer, arrived in Montreal the morning of October 19, 1912. He had a simple breakfast with a friend, and on coming out of the breakfast room remarked that he had a pain in his stomach and felt sick. His friend replied that nothing that he had eaten could hurt him, viz:—a little fruit, a cereal, a boiled egg, coffee, and toast. In a few minutes he said, I must go up to my room and lie down. He just reached his room when he vomited some undigested food and a full pint of bright red blood. The vomiting was explosive in character. A physician was called and he applied ice to the abdomen and gave him a hypodermic injection of morphine ¼ grain with atropin 1/150. He remained in bed all day taking only sips of water and a little milk and soda water. At 9.30 in the evening he vomited a good quart of bright red blood. I saw him soon afterward. He was blanched, pulse weak, temperature below normal, suffering from air hunger and distress in mind. The room had the appearance of a shamble. The bed was soaked with blood, and blood was on the floor and rugs. He was removed to the Royal Victoria Hospital. Physical examination gave no evidence of cirrhosis or aneurism. An examination of the blood excluded leukæmia. In his personal history there was no indication of his being a bleeder. There was no history of bleeders in his family.

The stomach when uncovered appeared normal in size and shape. The transverse colon was filled with a dark clot and looked like a sausage. Rovsing's endoscope did not reveal the source of the hæmorrhage. On making an incision through the anterior wall of the stomach it was found filled with dark-colored blood clot, but no fresh blood. When the clot was cleared out, the mucosa appeared normal, no abrasions or fissures could be seen. There was no bleeding or oozing, even on handling and wiping the surface of the mucous membrane. A gastro-enterostomy was performed to anticipate and obviate distention, and the abdomen closed. An intravenous injection of 36 ounces of normal saline was administered.

He passed a fairly comfortable night and in the morning appeared bright and hopeful. There had been no vomiting. At 2 p.m. his condition was quite satisfactory. Half and hour later he vomited a large quantity of bright red blood, and died in a few minutes.

The findings, at the autopsy, were absolutely negative. A feature of interest was the abundance of hæmolymph nodes through the upper abdomen and along the aorta. One or two of these showed mottling with white as if they were occupied with secondary growth, but no tumor was found anywhere in the abdomen.

The blood showed an extremely delayed coagulation time. The psoas muscles were noted as particularly friable. There was thus no definite source of hæmorrhage to be found, and as a whole the viscera were all perfectly healthy. It would seem that there had been a diffuse oozing from all parts of the gastric mucosa. Hæmophilia was excluded by the personal and family history. The appendix was 9 centimeters in length. The mucosa of the appendix was œdematous.

In my own cases and in the cases reported to me by my colleagues, operative treatment has failed. The operation has consisted in brushing over the mucosa of the stomach as thoroughly as possible with the actual cautery and gastro-enterostomy. All patients died.

The two more recent cases that have been admitted to my service have been given transfusions of whole blood, not citrated. After the transfusions the bleeding stopped and the patients were discharged from the hospital.

[1] President's Address, Clinical Congress of American College of Surgeons, Philadelphia, October 24-28, 1921.

The history of blood transfusion is very interesting. It would seem to synchronize with the history of the Western Hemisphere. Strange as it may appear, transfusion was first attempted in the human with the object of giving young blood to an old man. "The vital powers of Innocent VIII were rapidly sinking. He had been lying for some time in a lethargic state, that was so deathlike as to make his attendants believe that all was over. Every means of restoring his exhausted vitality had been tried in vain, when a Jewish doctor proposed to attempt his cure by means of a new instrument for the transfusion of blood. Hitherto the experiment had only been tried on animals; but now the blood of the decrepit Pontiff was to be transfused into the veins of a youth, who gave him his own in exchange. Thrice in fact, was the difficult experiment made. It did no good to the Pope, and three boys, costing the sum of one ducat apiece, lost their lives, through the introduction of air into their veins. The Jewish doctor then fled, and on July 25, 1492, Innocent VIII finally expired." [1]

Samuel Pepys, F.R.S., and secretary to the Admirality in the reign of Charles II and James II mentions in his diary what he calls a pretty experiment at Gresham College, of the blood of one dog let out, until he died, into the body of another on one side, while his own ran out on the other side. The first died upon the place, and the other did very well, and is likely to do well. He then goes on to say. "This did give occasion to many pretty wishes, as the blood of a Quaker to be let into an Archbishop and such like: and as Dr Croone says, may if it takes, be of mighty use to man's health, for the amending of bad blood by borrowing from a better body."

Apparently blood in its purity was the desirable objective as indicated by the following narrative, also from Pepy's diary. A man that was a little frantic, that had been a kind of minister, Dr. Wilkins saying that he had read for him in his church, a poor debauched man, was hired by the college for 20 shillings to have some of the blood of a sheep let into his body. They proposed to let in about 12 ounces, which they computed would be what would be let in in a minutes' time by the watch. Pepys met the man afterward, when he said he found himself much better and as a new man. Pepys adds that the man is cracked a little in his head though he speaks very reasonably and very well. He had but 20 shillings for his suffering and is to have the same thing again tried upon him.

DaCosta of this city gives a very interesting résumé of the history of transfusion, mentioning the work of Lower of Oxford and Sir Christopher Wren in 1665, and Dr. Croons' experiment in 1666.

We are more familiar with blood transfusion for blood lost. The blood in some cases has been taken from animals. As a student, on two occasions I assisted one of my old teachers in transfusing blood from a sheep to men suffering from railroad injuries and great loss of blood. Unfortunately they were not successful. The predominant idea was to replace what had been lost

Human blood, whole or defibrinated, was for many years regarded as the correct treatment of exsanguinated patients. It was afterward found that any suitable innocuous fluid gave apparently as good results when injected into the veins as did blood: that the essential was to restore a degree of arterial tension and render the heart's action effective. Normal saline solution was the fluid generally selected. It was easily prepared, the immediate results were good, there was freedom from the risk of embolism and it entailed no sacrifice of blood by another. The experiences of the war changed our views. It was shown by Crile and confirmed by others that blood transfusion restored the blood pressure to a greater degree and that the results were more lasting than the injection into the veins of saline solution. The greater efficiency of blood transfusion may be ascribed to the contained colloids.

Transfused blood has been found helpful in many conditions but particularly in hæmorrhage and in shock following hæmorrhage. It was the experience of medical officers during the war, as stated by Primrose and Ryerson, that two definite results may be confidently expected from transfusion: viz., increased coagulability of the blood and increased

[1] Life and Times of Savonarola-Villari.

resistance to infection. It is probable that these two actions of the transfused blood explains its value in cases of gastric hæmorrhage without discoverable cause and in the hæmorrhage of the newborn.

That the hæmorrhage is the result of some infection, the nature of which is not yet understood, seems highly probable. In recent years there has been an increasing tendency to regard melæna neonatorum as a manifestation of a micro-organismal disease. Since Klebs, in 1875, found micro-organisms in the blood and in the tissues in cases of hæmorrhage and especially in melæna, many observers have confirmed his observations, including Weigent, Eppinger, and Rehn. In the blood of newborn children who died of hæmorrhage they found organisms which when injected into young rabbits produced hæmorrhages in them

The source of the infection remains to be determined. One thinks of the tonsils, the teeth, the gall bladder, the appendix vermiformis and the renal pelvis. Internists and surgeons can recall cases of indigestion, of gastric symptoms simulating duodenal and gastric ulcer, relieved by appendectomy. Over twenty years ago Dieulafoy taught that in many cases of appendicitis, toxins were formed capable of producing jaundice, albuminuria and hæmaturia, and also gastritis and hæmatemesis: and that the hæmatemesis might be severe, recurrent, and fatal. He thought that ulceration of the arterioles lying beneath the muscularis, mucosa was the immediate cause and source of the hæmorrhage. Moynihan has reported cases of gastric hæmorrhage apparently caused by toxins produced in the appendix, and the writer has seen cases of gastric hæmorrhage that did not recur after the appendix had been removed.

Some day some bacteriologist, following the lead of Rosenow will identify and culture a specific germ as the causative agent in these cases of gastric hæmorrhage, in which neither at the operating table nor at autopsy any likely source of bleeding can be found: further, that if a larger experience demonstrates that in these cases the bleeding is arrested by blood transfusions, the logical conclusion would be that the transfused blood has increased the coagulability of the patient's blood and has increased his resistance to infection.

At the bedside, faced by a case of severe gastric hæmorrhage, one may make no mistake in giving a transfusion. At least time is gained for a careful study of the patient, his physical condition, his personal and family history and the operation would put him into a better condition to stand active surgical treatment if found to be indicated.

GROWTH PROBLEMS FOLLOWING OSTEOMYELITIS OF ADOLESCENT LONG BONES[1]

BY KELLOGG SPEED, M.D., F.A.C.S., CHICAGO

ONE of the serious and unhappy results of acute osteomyelitis of adolescent bones is that of growth disturbance. It is my intention to discuss this infrequent phase of acute bone infections from a clinical standpoint, reviewing the excellent experimental work that has been undertaken, dating back to 1872, to offer some practical suggestions for treatment, and to call attention to a few irregularities in the bone pathology. Although most of the experimental work has been directed at the epiphysis, the subject seems not to be confined entirely to derangements of that portion of the bone, as I believed when first studying it. There are few specific references in the literature to interferences in growth after epiphyseal separations. Likewise after acute inflammatory attacks in bone, there are not many reported instances. But the extent of the field involved in the study of interference with adolescent bone growth may be inferred from a few references. Krabbe of Copenhagen[2] in studying 150 children suffering from precocious puberty whose bones were examined by X-ray, found one case of pubertas præcox in which there was a complete synostosis of the epiphyses of the long bones at an age of 7 or 8 years, resulting in marked curtailment of the skeletal growth. He states that there are some 6 other like cases to be found in the literature. No definite inflammatory attack could be traced in these patients. Froelich[3], describing growth epiphysitis, grouped under that head Schlatter's disease, Koehler's disease, juvenile arthritis deformans, trochanteritis, epiphysitis, especially of the fourth and fifth metacarpals, scaphoiditis, and epicondylitis. These conditions all appear at points where the skeleton is very actively growing; they pursue a mild course and are believed to be an attenuated form of growth osteomyelitis. Vulliet[4] reported two instances of lesions of the epiphysis of the calcaneus in boys 11 years of age. These he believed were to be classed with juvenile deforming osteochondritis and Schlatter's disease. The clinical importance of these variously named, mild, bone infections lies in mistaking them for tuberculosis of bone and in a possible misinterpretation of the remarkable efficiency of certain treatments applied. An instance of the relationship of fracture of the lower epiphysis of the tibia to the arrest of growth of the bone was reported by Elmslie[5]. This fracture resulted in arrest of tibial growth and resulting bowing of the fibula which continued to grow normally. A roentgenogram of the involved epiphysis showed that the outer part of the affected epiphyseal area had a normal continuance of growth, while the inner portion showed a marked sclerosis with stoppage of growth. For the acute inflammatory types, we have a report by Hentschel[6] in which he refers to his dissertation (Jena, 1908) and cites an instance of interfered with growth of the tibia following osteomyelitis of the upper end of the bone. He collected a series of cases and was inclined to divide the subject into the following points of clinical interest: (1) shortening of the affected bone, (2) lengthening of the affected bone, (3) defects in the bone, (4) pseudarthrosis, (5) bending and other deformities. McWhorter[7] reported an instance of osteomyelitis with variation in growth of the femur following separation of the distal epiphysis. His patient, 13 years old, had already a shortening of 1½ inches and skiagraphic verification of obliteration of the involved epiphysis. This result followed an infected epiphyseal separation. An instance had been seen by him also in a man 45 years of age who had suffered a bone abscess of the tibia in his twelfth year. There was an increase in the length of the leg

[2] Endocrinology, 1919, Oct. Dec., iii, 3, 157.
[3] Paris méd., x, vi, 430.
[4] Schweiz. med. Wchnschr., 1920, Dec. 17, l, 1165.
[5] J. Orthop. Surg., vol. i, 215.
[6] Ztschr. f. orthop. Chir., 1908, xxii, 1917.
[7] Surg. Clin., Chicago, 1919, Dec., 1449.

[1] Read before the Chicago Surgical Society, December 12, 1921. (For discussions, see page 553.)

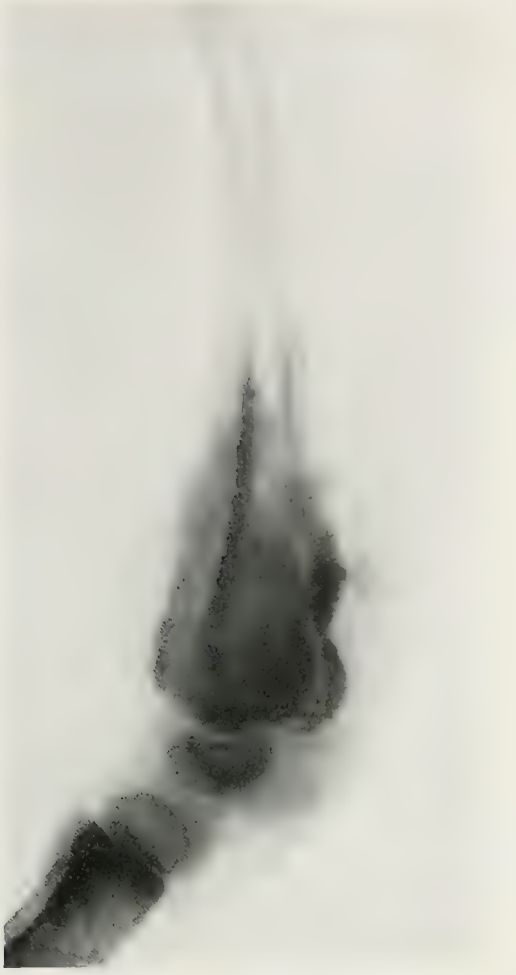

Fig. 1. The ordinary osteomyelitis of the shaft of the femur in childhood. Involucrum and sequestrum formation have taken place but the epiphysis seems spared. Such a condition requires delicate operative technique to avoid wounding the cartilaginous plate. Prognosis as to growth good.

amounting to 1¼ inches, a stimulating lesion.

Various factors may influence the growth of long bones, of which we may recall: (1) loss of blood supply, (2) disturbances of the endocrine system, (3) inflammation or disease of the bone, especially the epiphysis, (4) trauma of the bone (fracture with or without injury of the epiphyseal cartilage).

The experimental work in this line dates back to Bidder[1]. He inserted needles into the epiphyseal cartilage plate of the bones of dogs, sometimes driving the needles through to the opposite side. Whichever side of the cartilage plate was injured ceased growing, so that bowing or angulation deformities followed in the limb. If the whole width of the cartilage plate was damaged, there was a uniform hindrance of longitudinal growth, the plate becoming replaced by connective tissue or bony trabeculæ. Ollier, Haab, Vogt,[2] and others after experimental investigation made deductions which found acceptance in surgical teaching for many years. By mechanical stimulation of the diaphysis near the epiphyseal cartilage plate, the bone length might be increased and minor lesions of the plate had little effect on the long growth. More extensive lesions or excisions of the cartilage plate resulted in shortening, but when an epiphysis was separated and immediately replaced no interference with growth resulted. When, however, the cartilage plate was fully excised, there resulted complete stoppage of growth at that point.

It was Haas[3] who carefully and quite conclusively investigated two points in the long growth of bones, namely the relation of the blood supply to the longitudinal growth and later the localization of the growing point in the epiphyseal cartilage plate of bones. In estimating the influence of the blood supply on growth, he used the metacarpal and metatarsal bones of dogs. He found that—

1. Ligation and destruction of all the vessels on the dorsal surface of the dog's foot caused no disturbance in longitudinal growth of the metatarsal bones.

2. Cutting off the entire blood supply of the epiphyseal end of a metacarpal or metatarsal bone results in marked lessening of the long growth of the bones even though the main nutrient artery remains intact.

3. If the nutrient artery is destroyed there will be practically no disturbance in length growth, provided the epiphyseal blood supply is not injured.

4. If both epiphyseal and nutrient supply are simultaneously destroyed there will be

[1] Arch. f. Exper. Path. u. Pharmakol., 1873 1, 248.

[2] Arch., klin. Chir., 1878, xxii, 343.

[3] Am. J. Orthop. Surg., 1917, xv, 157; 305; 563.

Fig. 2. Epiphysitis of the calcaneus following acute infection. A sinus developed from the bone to the skin surface. Cured by one operation but the influence on the growth of the bone is as yet undetermined.

Fig. 3. Osteomyelitis of the upper end of the ulna, involving the epiphysis. Cured by approach through the olecranon without causing pyarthrosis in the elbow. Lack of growth at this point will cause little inconvenience.

greater loss of length than if the epiphyseal vessels alone are injured; in fact, in some cases there is complete cessation of long bone growth.

5. Maintenance of normal longitudinal growth of bone is dependent upon sufficient blood supply to the region of the epiphyseal cartilage plate.

6. Function exerts but little influence upon length growth of long bones.

Haas disputed the possibility of trans planting the epiphyseal ends of bones without disturbing length growth. In his effort to localize the growing point of long bones in the epiphyseal cartilage plate he concluded that—

1. An incision through a growing bone at the junction of the metaphysis with the epiphysis always causes disturbance in growth.

2. A separation in the natural line of cleavage between the epiphysis and metaphysis after incising the periosteum causes some loss in growth.

3. Excision of the metaphysis causes slight disturbance in growth.

4. Excision of the epiphyseal cartilage plate causes practically complete cessation of active longitudinal growth.

5. The most active and important elements necessary for longitudinal growth of bone are located in the columns of cartilage of the epiphyseal cartilage plate.

6. A limited property of producing length growth is possessed by the cartilage adjacent to the growth columns of cartilage.

In the light of much experimental work in the last 50 years, we may well agree with Haas[1] after accepting as a principal that the most important elements necessary for longitudinal growth of bone are located in the columns of cartilage of the epiphyseal plate that (1) the nearer the injury comes to the cartilage columns, the greater is the growth disturbance; (2) there is also a relation between the degree of destruction of the cartilage columns and the loss of growth; (3) disturbances of direct blood supply of the epiphyseal cartilage plate also have a marked hindering effect on the longitudinal growth of bone.

Acute inflammation of bone, arising either in the epiphyseal area primarily or spreading by continuity from the diaphysis may cause destruction of the cartilage plate and break down its cells to form pus as in acute suppurative osteomyelitis. The neighboring and immediate supplying blood vessels become blocked with thrombi and the normal epiphyseal arteries disappear. Lesser grades of infection as exemplified by Schlatter's disease, non-suppurating epiphysitis, etc., similarly may cause death of the growing cells in the cartilage plate resulting in necrosis without pus formation. In these types also the vascular supply may suffer when such an attack is resolved by an infiltration of round cells. Fibrous tissue usually supplants the growing cartilage cells and bone trabeculæ

[1] J. Orthop. Surg., 1919, i, 67.

Fig. 4.

Fig. 5.

Fig. 4. Osteomyelitis of the lower end of the radius with sequestrum formation. The lower epiphysis is involved by continuity, and growth seems to be stopped, inasmuch as the ulna has grown down past the proximal row of carpal bones. Note the radial deflection of the hand.

Fig. 5. Roentgenogram of same case as in Figure 4 some weeks after cautious bevelling of the radius, and drainage. The radial epiphysis appears to have taken on some growth again as the relative position of the radial and ulnar styloids have changed and appear to be approaching normal. The radial epiphysis also appears not to be closed by bony growth. A favorable case which bears watching before any further surgery is attempted. Dr. David.

may grow across the epiphyseal area, completely obliterating the growth power. When the young growing epiphysis is thus destroyed, and the action is rapid, we may compare the end-results after a few weeks to a mechanical destruction or excision of the cartilage plate. There will therefore follow all the phenomena that occur after experimental destruction or excision of the plate, or ruination of its blood supply, namely stoppage of growth or uneven growth resulting from partial obliteration. When the part involved concerns the limb where one bone forms the framework, the loss of length may be compensated by skeletal readjustments and by extra growth effort of the remaining epiphysis in that bone. If, on the other hand, one bone of 2 companions, as in the forearm or leg, ceases growth from one of its epiphyses, the analagous epiphysis of the fellow bone continues to grow and deformities result. The normally growing bone tends irresistibly to push the slower growing bone to one side as it lags behind and as this accident always occurs near joints the articulation may suffer restriction of motion and the whole limb loses a normal axial relation which interferes with function. Decubitus sores ultimately appear over the normally growing bone ends as they force themselves on past the joint (Fig. 12).

A clinical application of these experimental conclusions assumes particular interest where the forearm and leg bones are involved, more especially when *one* of the two companion bones suffers growth disturbance. Arrest or exaggeration of growth of the single bone of the arm is not so important. When one humerus is shortened as compared with its fellow in the other arm, little disability may result and the loss of length may not be noticed by the casual observer. In the thigh there is greater functional disturbance, yet the tilting of the pelvis may accommodate itself to the loss of length in the one leg and there need follow no deformity from overgrowth of a companion bone, none being present. (Fig. 11).

If we accept the conclusions of experimental work which tell us that the greatest interference with long bone growth results from destruction of the cartilaginous plate and the column of growing cartilaginous cells in the epiphysis, the 3 principal clinical conditions which may bring about this interference are fracture (epiphyseal separation), inflammation (osteomyelitis or epiphysitis), and operative removal of the cartilage. The same

Fig. 6 (at left). Osteomyelitis of the lower end of the tibia following open fracture and resulting in stoppage of growth of the lower, least important tibial epiphysis. Note the fibula continues to grow and is causing a bowing deformity of the leg. The osteomyelitic focus is quiet and apparently healed.

Fig. 7. Lateral view of the same leg as in Figure 6. A slight drop foot is present.

Fig. 8. Roentgenogram of two planes of the leg, same case as shown in Figures 6 and 7. The inferior tibial epiphysis appears to be completely obliterated and replaced by bone. A more slowly filling bone cavity exists in the metaphysis. In addition it is seen that the fibula has developed a cross union to the tibia. This followed an osteotomy to straighten the leg and has helped guard against the further bowing of the leg by holding the two bones together. Note the increase in the size of the lower half of the fibula because it is now bearing much of the body weight. The inferior fibular epiphysis is still ununited and the bone has grown down to the calcaneus past the ankle.

experimental work confirms our clinical knowledge that interference with the shaft of the bone (diaphysis) by fracture, surgical removal or inflammatory process even when the nutrient blood supply is destroyed, does not interfere with adolescent long bone growth. As the epiphyseal blood supply has a strong influence on growth, we must take operative precaution to preserve these vessels, especially those leading to the *epiphysis of greatest growth* in a bone.

However, we are confronted by some apparent inconsistencies in the application of this fact, as in one case after a patient suffered a fairly well-localized osteomyelitis of the diaphysis following open fracture of the radius which did not include the epiphyseal area, an arrest of growth resulted (Fig. 14). X-ray examination after 2 years failed to reveal in this patient that the epiphysis was closed, or that it differed roentgenologically from its analogous epiphysis in the other wrist. The osteomyelitic focus became healed following operation, and the bone was slightly sclerosed about the healed area, but the long growth did not proceed in a normal rate. Experimentally, a lesion at this site in the shaft of the bone would have little or no effect on the rate of growth; clinically, it did have. We must seek the cause in another direction. It may be found possibly in an assumption that the vessels leading to the nearby epiphysis became thrombosed and obliterated by the septic process, and pending the time when vicarious circulation might be established, the epiphysis in question ceased growth. On this account the deformity was treated conservatively with an expectation that growth would ultimately return to the area (Fig. 15).

Yet another pathological factor enters into the clinical interpretation of some of the instances of growth stoppage, and has great bearing on function and treatment. Atten-

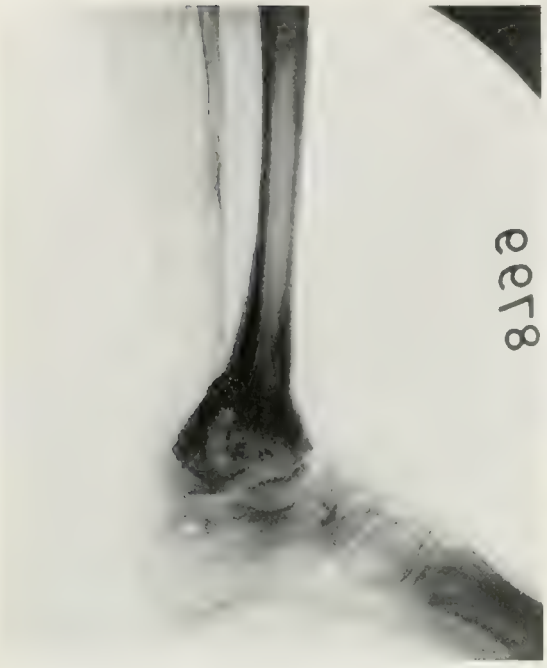

Fig. 9. A similar instance involving the inferior epiphysis of the tibia, now healed. From a growth standpoint it is fortunate that the fibula has been nearly obliterated and offers little support or tendency to cause bowing or other deformity.

tion is called to cross union between two bones in an extremity, particularly the forearm.

Fig. 10. Osteomyelitis of the radius following open fracture, healed. The lower radial epiphysis, although distant, seemed to stop growth. On its outer aspect it seems not to be obliterated. A cross union has taken place between radius and ulna, fortunately at a level too low down to influence pronation and supination. The ulna, however, on account of this union has been unable to produce bowing deformity as it is anchored to the radius and each bone is growing equally from its respective upper epiphysis. The lower ulnar epiphysis has grown on down nearly to the metacarpal bones.

Fig. 11 (at left). Osteomyelitis of two years' standing, healed. The upper epiphysis of the tibia has been involved and the leg as a whole is shortened from the knee down. Pelvic tipping and scoliosis accommodate for the shortening. The foot is in fair weight-bearing position.

Fig. 12. Lateral view of the leg in Figure 11. Note that the fibula has continued its growth. In this leg the most important epiphysis has been obliterated and in contrast to Figure 7 the shortage of the leg is more marked. Splinting has saved much bowing of the leg, but the extremities of the fibula are growing beyond their respective joints and the pressure on the skin over the protruding bone ends threatens necrosis.

Following the septic process which usually involves the epiphyseal cartilage plate, a deposition of bone may pass through the tissues or across the interosseous ligament to unite firmly the two bones by an osseous band. This is cross union (Fig. 10).

When the bone which has suffered destruction of its epiphysis heals it is found firmly united to its fellow by cross union. This in the forearm may interfere seriously with pronation and supination. As the fellow bone continues to grow it has less tendency to produce a bowing of the forearm, but as it grows down past the carpal bones it causes a more marked deflection of the wrist, and that coupled with the loss of rotation entails a greater disability. The treatment we suggest is also less promising in this class (Fig. 8). Multiple joints in the same patient may be involved in growth disturbance.

Fig. 13. Healed osteomyelitis of the radial shaft following infected open fracture. The lower radial epiphysis has stopped growth and the projection of the ulnar styloid downward past the wrist is clearly seen. Considerable functional loss.

Fig. 14. Roentgenogram of the forearm in Figure 13. It can be seen that the inferior epiphysis of the radius does not appear closed but the ulna has grown well down below the wrist joint.

Fig. 15. Postoperative roentgenogram of forearm in Figure 13. Note the site of resection of the ulna, its union, and the retraction of the ulnar styloid to its normal level. If cross union were present this could hardly be performed. The lower radial epiphysis does not seem to be obliterated by bone but growth has ceased in it for more than 2 years. Obliteration of the epiphyseal vessels may account for its lack of growth.

Fig. 16. Lateral view of the forearm in Figure 13 after operation. Viewing across the wrist joint shows the normal level of the articular surfaces of the ulna and radius. The patient awaits further evidence of stoppage of growth in the lower radial epiphysis after which the lower ulnar epiphysis may be excised and the two bones will then grow evenly.

TREATMENT

Because no amputations have been performed for this type of deformity, it has been impossible to obtain specimens of human bone for study. An effort is always made to alleviate the condition in leg or arm without causing further injury. The treatment may be divided into prophylactic and active. Prophylactic treatment concerns:

1. Early operation on shaft osteomyelitis of adolescent bones before the epiphyseal areas become involved or their vessels thrombosed and obliterated.

2. Extreme conservatism in draining acute suppurative epiphysitis of adolescent long bones.

a. Cut open the periosteum by means of one longitudinal incision; do not reflect it any more than necessary;

b. Never use a sharp curette in the epiphyseal area; wipe out granulations and drain;

c. Immobilize the limb in a suitable splint or dressing; best with some traction in extension so that a pathologic dislocation may not follow, also so that drainage will be efficient.

3. Warn parents of possible growth interference and examine patients frequently with X-ray after healing takes place.

4. If growth seems arrested, apply suitable splint or apparatus to prevent deformities while waiting for growth to recommence. This means in the leg especially a provision against early weight bearing without proper caliper support.

5. Protect skin over growing ends of healthful companion bone, so that pressure sores and infection may not develop.

Active treatment. Although these problems most generally concern arrest of growth and occur in adolescents, the principles of treatment suggested might apply to overgrowth or to the correction of deformities in the adult. One must consider the age of the patient. The surgeon who undertakes a curative or palliative operation must bear constantly in mind the remaining years of growth as well as the actual number of inches of growth that await the patient. In the leg this is especially important because weight bearing on a limb deformed from this cause may be seriously interfered with by mal-

positions of the foot from local length changes, by infected pressure sores over the ends of the normally growing bone, and by changes in gross length of the limb which lead to pelvic tilting, scoliosis, and change of gait. I have adopted therefore the following rules of treatment:

1. Remember the law of nutrient arteries in relation to growing long bones, i. e., the nutrient arteries are directed toward the elbow and from the knee, and the epiphysis toward which the artery is directed unites first. The fibula is an exception, of course. Consequently, the lower epiphysis of the femur, the upper epiphysis of the tibia, the lower epiphysis of the radius and ulna, and the upper epiphysis of the humerus all unite last in their respective bones and must be the most guarded.

2. Unless a bowing deformity in the leg or forearm tends to manifest itself rapidly and to cause great loss of function or threaten skin necrosis, splint correction of the extremity for at least 1 year is favored.

3. If both clinical and X-ray examination during the course of the year show that the bone is arrested in growth, a shaft resection of the companion bone, remote from the epiphysis, is performed to equalize length. Simple means (kangaroo tendon) of holding the resected ends in apposition are used, followed by a firm splint until union takes place

4. If the child is young (many years and inches of growth expected), after 2 or 3 years when it is quite positively established that the epiphysis of the damaged bone has ceased all growth and is obliterated, the analagous epiphysis of the fellow bone may be excised (epiphysectomy) to stop its overgrowth. Each bone then grows at an equal rate from the remaining epiphysis and there is no fear of subsequently appearing bowing deformity. Length deformity will persist.

DELTOID PARALYSIS AND ARTHRODESIS OF THE SHOULDER JOINT

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PARALYSIS of the upper extremities from all causes, the muscles being involved singly or in combination, is not as frequent as paralysis of the lower extremities. Paralytic conditions affecting the leg generally induce a patient to seek medical relief more readily than do those of the arm, for two reasons: (1) the lack of locomotion is felt more keenly than is the inability to perform certain manual tasks for which, after all, two limbs are available; (2) the therapeutic results, as far as the upper extremities are concerned, are on the whole not as striking and satisfactory as those on the lower extremities, which is mainly due to the fact that in the former case we have to deal with more highly complicated and specialized organs.

The foregoing facts explain why our orthopedic records show two or more lower limb cases for every arm case. Incidentally we have enumerated the chief reasons why the isolated deltoid paralysis is a rather rare object for treatment by the orthopedic surgeon.

The picture of this lesion (the changed contour of the shoulder, undue prominence of the acromion, coracoid and humerus head, subluxation of the joint, inward rotation of the arm, the flail shoulder with the limb a practically useless appendix of the body) is all the more lamentable, since the well-preserved function of the forearm and hand is rendered worthless through the inability of the patient to move them to the desired place of action. Another point which is generally not sufficiently evaluated is the fact that, through continuous overtension of the flexors and extensors of the upper arm, in the course of time, these muscles become as useless as the deltoid itself and serve to augment the misery.

The treatment of both the recent and old condition may be divided into three categories; the preventive, the palliative, and the curative. While the first is said to confine itself to the prevention of complete paralysis by electricity, gymnastics, and massage, restoration of a completely paralyzed deltoid by these means must at least remain doubtful. In the cases reported we probably have to deal with only partial degeneration or with vicarious action of auxiliary muscles, especially the supraspinatus.

All preventive measures must necessarily end in fiasco, if they are not preceded or assisted by correction of the subluxation and overstretching of the muscles surrounding the joint. Therefore the wearing of a Schuessler aircushion apparatus or one of the appliances devised by Hoffa (1), Billroth and others, is indispensable. However, braces of any kind have one important disadvantage. Besides failing to provide the lost deltoid function, they interfere seriously with the substitution of this function by the muscles of the shoulder girdle. Thus the palliative treatment as attained by orthopedic apparatus of Hoffa, Vulpius (2), Silver and others, fixing the shoulder joint in a prearranged and, as far as the forearm and hand are concerned, most advantageous position, naturally must remain nothing but a poor substitute for methods to be discussed later.

Consequently, while the medico-mechanic treatment, as applied to recent or partial deltoid paralysis, often may be used with more or less success, inveterate cases must be subjected to surgical procedures. The methods in question are curative in the sense that they either provide the paralyzed deltoid with a new nerve supply (as by nerve grafting) or supplant the lost muscle action by another muscle (muscle transplantation) or they substitute the muscles of the shoulder girdle as a whole, after union of the humerus and scapula—arthrodesis.

The nerve graft has been applied in different variations: fifth into sixth cervical, by Harris, and Low (3); median, ulnar, and radial into axillary, by Vulpius Stoffel (4); subscapulary into axillary, and fifth into seventh cervical. Lengfellner and Frohse (5), and especially Stoffel, have made minute investigations into these conditions and have put the deltoid nerve surgery on a firm anatomical and physiological basis. But, as far as the results are concerned, they leave much to be desired. The applicability only to fresh cases with little degeneration, the long time of waiting for success, the complicated after-treatment, and then, in the best event, a rather weak deltoid action, do not elevate the nerve transplantation very much above the results obtainable by medico-mechanic therapeutics.

The muscle or tendon transplantation offers the second possibility of replacement. In 1892 von Winiwarter made the first attempt at replacing a paralyzed deltoid by a part of the pectoralis major with a moderately good result. Later Hoffa (6) used a part of the trapezius. So did Bradford (7), Dean Lewis (8), and Tubby (9). The cuts illustrating Hildebrandt's method (10), in every book on surgery, vouch for this author's success. Lengfellner and Frohse (11) also investigated this subject extensively with results which are well worth studying by one interested in these procedures. Only the uncertainty of the results and the magnitude of the operation with its resulting scars and deformation leave not much room for doubt that for some time to come, a much simpler operation with more positive results will be the method of choice. I have in mind the arthrodesis of the shoulder joint.

The development of the shoulder arthrodesis operation dates back as far as 1879, when Albert (12), the inventor of the principle of the arthrodesis operation, applied it in the case of a young girl. After him Wolff (13), Karewski (14), Hoffa (15), Bothézat (16), Vulpius (17), McMurray, Naughton Dunn (18) and others (19, 20, 21, 22, 23, 24) have done the operation with more or less satisfaction. The earlier operators failed to achieve bony union and therefore considered the shoulder joint not a very favorable subject for arthrodesis. Hoffa (15) says pessimistically: "The arthrodesis of the shoulder joint in any case must remain the *ultimum refugium* and can only be recommended as such. A true ankylosis cannot very well be produced by it." This latter

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 1. Left isolated deltoid paralysis and flail shoulder, after poliomyelitis. Changed contour, atrophy of deltoid, and secondary wasting of upper arm muscles are marked. Upward displacement of left shoulder by trapezius action (assigned by some authors to the operation itself and urged as an objection) is here shown to exist prior to operation.

Fig. 2. Ante-operative roentgenogram, showing subluxation of shoulder joint.

Fig. 3. Postoperative (12 weeks) roentgenogram of shoulder joint. The humerus is firmly united to the scapula, the bony fusion in the glenoid fossa is shown, the osteogenetic process is creeping up along the bone peg, toward the acromion. No absorption is found about the peg. The angle made by the outer edge of the scapula and the humerus is slightly more than 90°.

sentence hits the crux of the whole situation. If we desire an excellent and permanent result, we must avoid fibrous union by all means. Fibrous ankylosis interferes considerably with the endurance of function, the fibrous tissue not being able to stand the wear and tear. Fibrously ankylosed joints easily become tired even to the degree of painfulness and are much liable to subsequent contracture. More in the shoulder joint than in any other, only a sufficient bony fusion will meet the ideal purpose of the operation, which is to transfer motion, abduction, flexion, extension, and rotation from the muscles of the shoulder girdle through the scapula to arm and hand, a task involving considerable leverage, torsion and side strain, especially in case there is any weight to be handled by the arm. This statement is clearly borne out by a review of the cases operated upon, in so far as patients with proven bony union in correct position also show the best functional results. No wonder then, that surgeons in latter years, trying to free themselves from the pessimistic attitude of the earlier operators, see in bony fusion of the joint the ideal of the procedure and use every means of scientific advancement to attain their aim. In order to show how this is done with the outlook for a good result, a description of a typical operation for arthrodesis of the shoulder joint, used by myself, is given, followed by a discussion of the essential points, with a few illustrations at hand.

The essentials of a good technique are large access to the joint and firm fixation in the proper position. The paralyzed deltoid does not need to be considered. Generally it appears as a thin platysma-like, degenerated structure. The circumflex nerve also does not require consideration.

The operation is done as follows:

1. An incision 4 inches long is carried from a point half an inch internal to the acromioclavicular joint downward to the outer side

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 4. Postoperative view of patient, showing absence of scoliosis and position of scapula.

Fig. 5. Postoperative view of patient immediately after removal of plaster cast (12 weeks) showing strength of union; arm is held in horizontal position, and is unsupported.

Fig. 6. Postoperative view of patient, showing range of excursion that makes eating, hairdressing, etc. possible.

of the pectorodeltoid groove, embracing skin, fat and deltoid.

2. The joint is opened alongside and internally to the biceps tendon from the tuberculum supraglenoidale to the insertion of the capsule on the collum anatomicum.

3. Lift the tendon out of the sulcus intertubercularis and displace it laterally.

4. Now the capsule is dissected off the anatomical neck, backward and forward, rotating the arm inward and outward, until broad access to the joint is gained and the head of the humerus can be conveniently dislocated. The synovia then is excised and curetted away as thoroughly as possible, under careful observation of the integrity of the biceps tendon.

5. Rotate the arm strongly outward pushing the head of the humerus far out of the wound. With knife and rasp remove all cartilage down to the spongiosa. Subject to the same process the glenoid cavity, not only in its center, but also the borders, right out to the labrum glenoidale, carefully preserving the insertion of the biceps tendon. Vivify the lower surface of the acromion. It is polypragmaty to do the same with the coracoid process.

6. With an assistant fixing the scapula in normal position return the head into the capsule and in close apposition to the glenoid cavity and the acromion. In order to give the patient the most use of his hand the joint must be ankylosed with the humerus at about right angle abduction to the body, viz., the external border of the scapula from 80 to 110 degrees to the axis of the humerus, somewhat rotated inward and slightly flexed. This is the position by which the hand not only can reach the mouth, head and neck, but also the upper arm later will comfortably touch the lateral chest wall, while at rest.

7. With the arm in this position a hole is drilled through the acromion into the center of the humerus head, the drill left in place, a small dowel-peg secured from the tibia and, after removal of the drill, driven into the hole.

8. Now the smooth intertrochanteric groove, to the extent of about one inch, is transformed into a rough bony trough, by lifting up a bone-periosteum door, into which the biceps tendon is buried, with the door fastened over it by kangaroo tendon sutures; in other words, a tenodesis is performed.

9. Close the wound with fine catgut in layers, taking up the slack in the capsule.

10. Immobilize over aseptic dressings by a plaster cast embracing chest, shoulder operated on, extending to the middle of the

forearm, with the elbow in flexion, such immobilization to last undisturbed for 12 weeks.

The main points of the operation described are: first, most thorough removal of the synovialis; second, the most radical removal of all cartilage down to the spongiosa; third, the strict avoidance of all foreign non-absorbable fixation and suture material; fourth, the use of the upper part of the biceps tendon for a fixation purpose.

As to the first point, Sir Astley Cooper (25) a hundred years ago has drawn our attention, among other causes for non-union of intracapsular fractures of the hip, to the detrimental action of the joint fluid, which forces its way between the fragments and thus efficiently prevents union mechanically and possibly in other ways. Others (26, 27, 28) from time to time, have enunciated the same fact. There is no reason for the belief that conditions in the operation under consideration (or in fact, in every arthrodesis) are not greatly similar. Consequently we must prevent the secretion of synovial fluid. This can efficiently be done only by the thorough excision of the synovial membrane.

The second important point of the operation is the removal of all cartilage. It is a well-recognized fact in bone surgery that the extensive contact and unobstructed access of the medullary osteoblasts to the scene of action make for success, while interposition of fibrous or its relative, cartilaginous tissue forbode delay and failure. Thus, from a mechanical as well as a physiological standpoint, extensive adaptation of the former joint surfaces, denuded of all cartilage, is essentially necessary.

As to the third point, the choice of fixation material, I have been fully converted to the view of Albee (29) who does not use non-absorbable material for the reason that it is conducive to irritation of the tissues, bone destruction, inhibition of bone growth, lowering of vitality and subsequent infection. Consequently, the use of wire, as applied by many surgeons in the past, is, to my mind, a surgical sin, which ought not to be committed in the presence of physiologically correct material. In the case *sub judice* autogenous bone graft and kangaroo tendon will satisfy the taste of the most fastidious operator and their use cannot be recommended highly enough. The fixation by bone graft dowel peg, a child of the inventive mind of Albee, is recommended and used by this author also, in the arthrodesis of the shoulder joint. It not only furnishes an excellent means of firm fixation, but also stimulates osteogenesis and osteoconduction eventually leading to a strong union between humerus and acromion which can not be obtained in any other way. Most of the other authors have used wire or silk. In this respect it is interesting to hear what Lange (30), one of the most ardent investigators and advocates of foreign body implantation has to say. According to this author tin (stannum) is the metal most acceptable to the tissues, while all other metals, especially silver, lead to severe irritation. "Silk may easily and as a rule permanently heal in, after it has been boiled in a solution of hydrargyrol oxycyanide 1:1000." But why, I ask, use these materials, after the non-irritability of autogenous bone and kangaroo tendon has been proven beyond doubt by practical use in hundreds of cases?

The innovation of the intra-osteal tenodesis in this operation has suggested itself to my mind for the reason that after the arthrodesis there is no more use for a sliding tendon over the shoulder joint. Thus the point of origin of the biceps tendon may just as well be transferred onto the upper end of the humerus and the supra-articular portion of it used for the strengthening of the superior circumference of the arthrodesis, where the strain is greatest. This arrangement incidentally makes for the most advantageous working of both Roux's and Wolff's laws, thus securing the ideal of the operation, bony union.

Under point five of the description of the operation I have thought it superfluous to pay any attention to the coracoid process as advised by a number of surgeons. A look at the anatomical conditions will tell the reason. It is hardly possible by any manœuver to bring the head of the humerus into apposition with the glenoid fossa, the acromion and the coracoid process at one and the same time, unless one chooses to fracture the acromion,

as one author suggests. This in my mind is an unnecessary act and out of proportion to the advantage gained.

The question, as to when the arthrodesis of the shoulder joint is indicated, from the foregoing may be easily answered. Any case of flail shoulder, with fairly well preserved spino- and thoracoscapular musculature is a fit subject for the operation. In addition it may be mentioned that in the interest of the upper arm muscles it is desirable to operate on these cases, before overtension and the atrophy of inactivity have had their telling effect; in other words, as soon as the fact of a permanent paralysis of the deltoid is well established.

Failure, complete or incomplete, in the outcome of the operation, which means lack of humeroscapular fixation or uselessness of the arm, will be extremely rare, as long as the operation is done after proper evaluation of pre-operative conditions and with careful observation of the technique described.

Among the disadvantages of the procedure have been mentioned: the formation of fistulous tracts with the expulsion of the foreign materials used, an objection which is void with the use of the technique discussed; second, two disadvantages of a cosmetic nature, the upward displacement of the scapula by trapezius action (Fig. 1) and the supposed secondary scoliosis. Both of these latter points have been proven to be without significance by Vulpius (31).

Accordingly, we see that the advantages of the operation, which may be summed up by stating that a useless extremity of the body is reinstated and a hopeless condition for all practical purposes cured, far outweigh the only real disadvantage, viz., the creation of a pathological condition by stiffening a movable joint.

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HUMAN ACTINOMYCOSIS

With Special Reference to Source and Mode of Infection

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ALTHOUGH the disease "lumpy jaw" in cattle was first described by Le Blanc in 1826, it was not until 1877 that Bollinger and Hartz discovered the specific micro-organism and gave to it the name actinomycosis bovis. Israel and Wolff shortly afterward isolated the same organism in pus of an empyema in the human subject. Since the discovery of Wolff and Israel, there have been many and varied human manifestations of this disease reported in the literature. This is especially true for the past decade due in a large measure to the fact that many of the earlier cases went undiagnosed, though some investigators believe that this disease is gradually becoming more prevalent in this country.

BIOLOGICAL CHARACTERISTICS

Widely different descriptions of the biological characteristics of the specific micro-organism have been reported. The first extensive biological studies were made by Bostroem (1), who, in 1890, published a report of cultures from 11 cases of actinomycosis of the jaw in cattle. The micro-organism obtained from each of the cases apparently belonged to one species. This micro-organism he describes as one which grew best under aerobic conditions on all culture media in the form of masses of branching filaments forming nodular membranes or layers which assumed more or less of a reddish color. In old cultures the surface of growth became white in color and this change in color corresponded to the transformation of the superficial filaments of the growth into rods and round coccus-like bodies. These coccus-like bodies he regarded as of the nature of spores. The organism grew at room temperature on all media and even on sterilized water.

Wolff and Israel (2), one year later, report having isolated from two cases of actinomycosis in man an organism with totally different cultural characteristics from that of Bostroem. The organism they isolated grew best under anaerobic conditions and did not grow at room temperature. Its growth was much less luxuriant than that of the Bostroem organism. Animal inoculation gave the typical lesions of actinomycosis in each instance.

Wright (3), in 1905, reports results of a biological study of micro-organism of actinomycosis which closely parallels the work of Wolff and Israel. He isolated the organism in pure culture from thirteen cases of actinomycosis in man and from two cases in cattle. These micro-organisms he believes to be all of one species as the difference among the various strains were no greater than among the various strains of tubercle or diphtheria bacilli. He found the organism to be essentially an anaerobe which grew well only in agar and bouillon cultures and in the incubator. In other culture media and at room temperature its growth was slight or not at all. The clubs of actinomycoses were produced only by immersing colonies of the micro-organism in animal fluids, such as blood serum and serous pleuritic fluid. He found all the strains studied capable of forming the characteristic club-bearing colonies in the tissues of experimental animals inoculated. As a result of his study he concludes that but one species of micro-organism is the characteristic infectious agent in typical actinomycosis and that is one with the properties and characteristics of the organism he has described. He does not accept the work of Bostroem, because Bostroem did not show an agreement in morphological and biological characters between the micro-organism of the cultures and the micro-organism of the lesions, as he did not reproduce in his cultures characteristic pathogenic action upon animals as his animal inoculation experiments failed to reproduce the lesions of actinomycosis.

In view of the fact that Bostroem found the micro-organism in only a very small pro-

portion of his cultures, Wright believes it highly probable that the organism described by Bostroem to be due to a contamination by one of the nocardia group which differs widely from actinomycosis in having spore-like reproductive elements and being widely disseminated in the outer world. That a nocardia ever forms the characteristic lesions of actinomycosis in man or cattle has never been convincingly shown, and therefore infections by these organisms he believes should be called nocardiosis and not actinomycosis; the latter term he would reserve for all cases of infection with the true actinomycosis bovis micro-organism.

There are many other published reports bearing on the biology of micro-organism of actinomycosis, most of which show much which is contradictory and confusing. Some writers believe the disease is due to infection with two or more distinct species of micro-organisms while others believe that only a single species is concerned. Further confusion has been brought about by some writers who have classed with antinomycosis certain other suppurative processes which differ from typical actinomycosis by absence of sulphur bodies, and which are known as pseudo tuberculosis or cladothrix infections. On the whole, the work of Wolff and Israel seems to have been most uniformly accepted and has been confirmed by careful and painstaking studies by Wright and others in late years.

ORIGIN AND MODE OF INFECTION

Because this organism does not grow well on all ordinary culture media and practically not at all at room temperature, Wright does not believe that it has its usual habitat outside of the body but that it is very probable that it is a normal inhabitant of the secretions of the buccal cavity and of the gastro-intestinal tract both of man and animals. though he has no proof to substantiate this theory. He believes that the part played by foreign bodies so often found in actinomycotic lesions is not that of carrier of the micro-organism into the tissues from without, but that the foreign body by its traumatic irritative effect furnishes a nidus in tissues, through which infection takes place from organisms normally present in the secretions of buccal cavity and gastro-intestinal tract.

In view of the observations of Wright, and the lack of any evidence that actinomycosis was a contagious disease, Lord (4) investigated teeth and tonsils as a source of infection. From the contents of carious teeth and tonsillar crypts of patients without actinomycosis he made intraperitoneal inoculations of guinea pigs, and succeeded in producing omental tumors histologically identical with actinomycotic tissue and containing typical club-bearing actinomycetic granules in three out of five animals inoculated, or 60 per cent of the inoculations in both instances. This he believes indicates the buccal cavity as the source of the disease. In explanation of the infrequency of the disease compared with the numberless chances for infection he cites five negative inoculation experiments in his series, in which organisms resembling actinomycetes were present in the smears from the extracted material, the organism having failed to multiply in the body of the animal, due as in other infections to the varying numbers and vitality of the seed and fertility of the soil. Another factor of probable hindrance to infection he believes is the number and virulence of organisms occuring as a mixed infection with actinomycetes.

That Lord by his work has demonstrated that the organism of actinomycosis may be an inhabitant of the oral cavity in cases showing no clinical manifestations of the disease cannot be questioned; however, it does not materially strengthen the theory of Wright that this organism is a normal inhabitant of the oral cavity and gastro-intestinal tract. The fact that true dichotomy sometimes occurs in leptothrix according to Israel, renders it impossible at times to differentiate leptothrix from the streptothrix forms of actinomyces; in fact he reports having found forms in colonies of leptothrix from dental mucus, which had analogous growth to the clubbed bodies of actinomyces, but differing in having no radial arrangement. The possibility of Lord having dealt with this organism in his negative inoculation experiments is open to consideration.

It would hardly seem possible that the organism of actinomycosis could exist as a normal inhabitant of the oral cavity and gastro-intestinal tract without giving rise to pathological manifestations more frequently than it does. The dentist and oral surgeon would surely encounter this disease quite frequently following manipulations about teeth and oral cavity causing abrasions of gums and oral mucous membranes, a predisposing condition to infection—yet such infections are unheard of. Likewise in surgery of the gastro-intestinal tract, the same holds true. Never in all the thousands of operations performed at the Mayo Clinic, has there been a single case recorded of postoperative infection by this organism. Neither do we find a single case reported in the literature where such infection has taken place.

There is much evidence pointing to a source of infection originating outside of the human body. Most writers are agreed that the organism when not living as a parasite on man and other animals is essentially either a saprophyte living in the soil, or parasites of higher forms of vegetable life.

Some observations have recently been made at the Agricultural Experiment Station at Geneva, New York, by Conn (5), who by culturing various soils has shown that actinomycetes average about 38 per cent of the total flora of sod soil, and only 20 per cent of the total flora of soil under cultivation, or nearly twice as plentiful in sod as in soil under cultivation. He has also shown that the number of actinomycetes in sod soil increases as the sod grows older. He states that observations are at hand indicating that actinomycetes occur in the soil not as filaments, but as chains of short rods or cocci closely resembling ordinary bacteria. Considering this as the normal mode of growth of this organism in the soil he gives two explanations for his findings. One is that sod soil is more favorable for growth of the organism under anaerobic conditions. He, however, did not find a decrease in the actinomycetes by aerating the soil. The other explanation which has been considered is that the actinomycetes are active in the decomposition of grass roots or perhaps of plant roots in general.

Liebman has been quoted by Chretien (6) as having performed some interesting experiments on seed inoculations with actinomycetes. He inoculated the seeds of beans, lentils, and barley, and the plants and the parasites developed simultaneously. The plants were invaded by short rod like bodies, and by forms of the fungus found in animals as well. He was able to infect animals from these and also succeeded with his inoculations into other media. He also pointed out that the streptothrix actinomycotica becomes attenuated by passing through the animal body, but regains its virulence after being grown on a plant.

The observations of Conn and of Liebmann are of interest when applied to the reported endemics of actinomycosis among cattle fed on grain from certain fields. Jensen (7), a veterinarian, reports an endemic of actinomycosis in Seeland due to eating rye grown on newly cultivated soil reclaimed from the sea. He mentions an instance of a farm, where nearly the whole of the young stock, about thirty in number had actinomycosis after feeding on mixed forage grown on a certain field. Two years later the same disease occurred in the same stalls in four animals after being fed on barley straw from the same field.

According to Jensen the fungus grows on grain, husks, and straw of different cereals, but most abundantly on barley, which is also [illegible] to wound the mucous membrane. observations tend to [illegible] view, for in twenty-two out of twenty-four cases in which he found barley sticking in the tonsils of pigs, he found the beard thickly beset with a fungus very similar to, if not identical with, the ray fungus. Bostroem found the remains of grain or its sheath in lesions of eleven of his cases. Numerous observations similar in nature have been made since.

McKenty (9) has likewise noted the endemic nature of the disease, in reporting thirty-seven cases of human infection at the Royal Victoria Hospital at Montreal. He states that with the exception of three or four cases they all come from locations within a hundred miles of Montreal. One small

strip along the St. Lawrence River furnished a large number of the cases, and the other locality was south of Montreal and in the Eastern townships. Older writers frequently speak of endemics occuring in the salt marshes of Europe, as well as newly cultivated lands reclaimed from the sea.

That grain and grasses play an important rôle in human infections as well as in animals has been convincingly shown clinically.

Soltmann (10) reports a case of infection in a boy 11 years old as a result of swallowing an awn of wall barley. The boy became very ill and suffered great pain behind the sternum, extending to the back. An abscess formed, covering an area extending over six intercostal spaces, and when opened the awn of barley was found in the evacuated pus. A subsequent examination of the pus showed infection to be actinomycosis.

A similar case is reported by Cope (11) in a boy of 10, who accidentally swallowed a blade of grass which lodged in region of right tonsil. Subsequently a swelling developed behind the angle of the right jaw. In a month's time softening occurred and abscess upon being opened discharged typical sulphur bodies. Later the piece of grass was discharged through the sinus.

In many cases where infection has taken place without grains or grasses acting as foreign bodies, there is a history of the patient having been habitual users of straw or blades of grass and hay as toothpicks, habitually carried there. Poncet reports such a case where the patient, an old woman, carried wisps of straw in her mouth with which to tie up the vines in her vineyard.

Maas (12) reports two interesting cases of infection from chewing grain. The patients were both strong and robust young men who, prior to their illness, were occupied in unloading a stranded wheat steamer in Lake Erie and frequently chewed the raw grain. Both subsequently developed actinomycosis in the cervical region. A parallel case is reported by Leith whose patient carried raw grain in his pocket to chew on at odd moments.

Hummel (13) reports a case of actinomycosis of upper jaw caused by a piece of oat chaff which had evidently entered through mucous membrane of mouth. He states that twelve other cases have been reported in the German literature in which the infection was found to be due to a foreign body, usually a piece of barley-corn or some other kind of grain.

Thus it would seem that clinically at least grains and grasses are well established sources of infection in human actinomycosis as well as among cattle. That the nature of the soil on which grains and grasses are grown is a factor in its ability to produce infection also seems plausible, in view of the reported endemics among cattle and the experimental evidence of Conn and of Liebmann.

Since Wright by his cultural experiments has shown that the organism of actinomycosis, as found in man and lower animals, is not capable of existing in the outer world, it seems highly probable that this organism must be capable of a dual existence. In the outer world its existence is that of a soprophyte in the soil, which under certain conditions is capable of becoming parasitic upon higher forms of vegetable life, and in this state it assumes its pathogenicity for man and lower animals. Once it gains access to the tissues it becomes attenuated and assumes totally different cultural and morphological characteristics, which are not in keeping with its existence in the outer world. Whether or not this dual existence is due to the fact that the actinomyces organism is a spore former, is a mooted question among bacteriologists. The bulk of the evidence seems to favor the belief that it is not a spore-forming organism, but a true fission fungus which may be looked upon as a link between the bacteria on one hand and the lower fungi on the other. This in a larger measure seems justified by the habitat of the organism.

Direct transmission of this disease to man from lower animals has been denied by many observers. While direct inoculation experiments from man to lower animals have been successful there has not been a single case recorded in the earlier literature in which direct infection from lower animals to man took place. This is in keeping with our

knowledge of the parasite, since Liebmann has shown that the organism loses its virulence in passing through animals. There have, however, been a few cases reported in this country which would seem to show that direct infection is possible. Such are the two cases reported by Ochsner, one of whom drove a horse afflicted with "lumpy jaw" and the other a cattle dealer who frequently handled cattle affected with the disease. There is but one case on record in which direct infection from man to man has taken place. McKenty reports such a case in which a Royal Victoria Hospital nurse was infected by a patient with actinomycosis under her care.

That infection may take place by mere contact seems to have been definitely ruled out by Salmon (14) who put twenty-two healthy cattle with infected ones for a period of four months and not one of them developed the disease. Milk infection seems highly improbable as the mamæ of cattle are rarely infected and the disease is practically unheard of among infants. That infection may take place through improper meat inspection seems also out of the question as the ordinary process of cooking destroys the organism. Israel is satisfied that this means of infection can be ruled out, as he has noted the disease in many strictly orthodox Jews, who exercise extreme care in examining cattle intended for food. In view of such convincing evidence it is no wonder that many observers are inclined to disregard the possibility of transmission of this disease to man from lower animals. That it does take place, however, and more frequently than we have hitherto been led to believe, is manifest by the results of investigation of this series of cases.

The following questionnaire was prepared and sent to each of forty cases which had been treated at the Mayo Clinic prior to January 1, 1917.

1. Have you ever in any way come in contact with horses or cattle afflicted with "lumpy jaw" or any disease simulating it, such as old ulcers or swellings about the animal's head or neck?

2. Have you been in the habit of chewing on straws or blades of grass or picking your teeth with same?

3. To what extent have you eaten of fresh uncooked vegetables such as lettuce, celery, etc?

4. Have you at any time had decayed teeth or other tooth troubles?

5. Are you now, or have you ever been entirely free from this disease since you first began taking treatment?

6. State as accurately as you can what has been the course of the disease and what treatment you have carried out since leaving the Mayo Clinic.

As a result 26 cases were heard from and out of this number a definite history of animal to man infection was obtained in 15 cases or 57 per cent of this number had treated cattle for lumpy jaw prior to onset of their infection, while 2 had treated horses for suppurating wounds about head and neck of animal. Of the remaining 11 cases in which no history of exposure was obtainable, each and every one admitted a fondness for chewing grasses and straw and habitually picking the teeth with same. Each case also gave a history of dental caries and pyorrhœa to some degree. While this series of cases is not large it seems to emphasize the point that transmission of this disease from lower animals to man is more frequent than infection direct from grain and grasses; at any rate it is far more frequent than we had at first believed it to be.

The results of clinical and experimental study early brought out the fact that the organism of actinomycosis required a twofold condition in order for infection to take place. First, the organism must by some means be conveyed to one of the portals of entry of the human body. Second, in order for infection to take place an abrasion of some sort in the tissues is necessary. Johne and others fed cattle on virulent cultures and yet did not succeed in producing the disease. It was likewise noted clinically that cases of infection about the jaws and oral cavity never gave rise to infection in the gastro-intestinal tract. A clue to the necessity of an abrasion in order for infection to take place was given by the frequency with which infection took place following feeding of rye or barley to cattle, the beards of the grain frequently piercing the mucous membrane and producing the necessary abrasion. Israel and others frequently traced cervicofacial actinomycosis to carious teeth, which were always on the same side on which

infection took place. The rare cases of infection of skin and superficial parts of the body as a rule followed wounds or abrasions of some sort. The frequency with which infection follows lodgment of foreign bodies either in gastro-intestinal or respiratory tracts which pierce or cause abrasions of the viscera, all tend to establish without a doubt the necessity of an abrasion of some sort before infection can take place.

PORTAL OF ENTRY

By far the most common portal of entry is the oral cavity; next in frequency the gastro-intestinal tract; third, respiratory; fourth, through abrasions on skin.

In the oral cavity the most common site for infection to take place is about a carious tooth or where there is a pyorrhœal tendency. In a large percentage of this series of cases a previous history of dental difficulty was given. The trouble often begins with a toothache which patient cannot localize definitely to any one tooth. He often gives a history of having had several teeth extracted in an effort to relieve the pain. Subsequently there is swelling in the cervical region or jaw of affected side. One of the cases here reported began as a unilateral sore throat and subsequently developed a peritonsillar abscess on this side, which was lanced and proved to be actinomycotic. Two other cases developed on buccal mucous membrane, opposite a sharp carious tooth which had caused an abrasion in this region. One man was an inveterate tobacco chewer and said he always kept a cud of tobacco on this side of his mouth and frequently bit inner surface of cheek so it bled. Invasion from lower jaw and into cervical region is more frequent probably because the lower teeth are more frequently carious.

Infection is rare in the superior maxilla. Only one case in this series and one was reported in literature. Our case, began in the left upper second and third molars. He had had both teeth extracted. The swelling appeared in the left temporal region a few weeks later. It was incised and drained three times. Then it spread to the supra-orbital region and again drained. Backward extension took place through the orbit and in a few weeks patient developed meningeal symptoms and died.

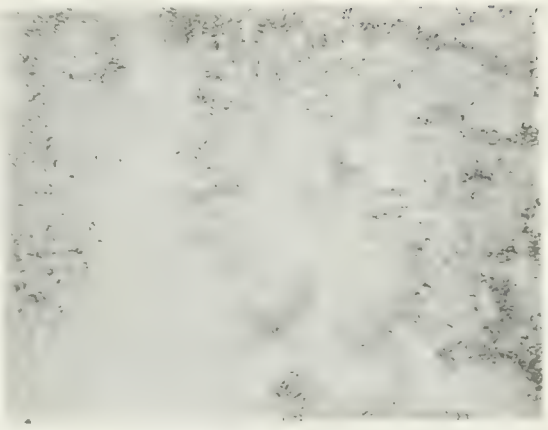

Fig. 1. Photomicrograph of actinomycosis smear showing radiate arrangement of clubs.

In the intestinal tract, there are two modes of invasion. One, which is very rare, is the generalized infection of the entire mucous membrane of intestinal tract. The fungus-filling glands of Lieberkuehn with a white coating over the entire surface of the mucous membrane consisting of mycelium of the fungus was first described by Israel. Only one case is reported in literature to date, that of Chiari. The other mode of invasion, which is quite common, is through the appendix. In the region of the appendix there is a stagnation of the fæcal current—favoring the lodgment of foreign bodies and the production site of small ulcerative areas. Perforation of swallowed foreign body may cause actinomycotic infection anywhere in gastro-intestinal tract.

In the respiratory tract there are also two modes of invasion: One through a catarrhal affection analogous to a bronchitis which is very rare, only one case being reported in the literature and one case in this series; the other and more common mode of invasion through a destructive disease of the pulmonary parenchyma itself. If no pleuritic adhesions form the disease may run a course similar to ordinary tuberculosis. However, if pleura once becomes involved, there is rapid spread by continuity to the chest wall. The most frequent mode of infection is

Fig. 2. Cervical actinomycosis with discharging sinus and linear puckering.

Fig. 3. Actinomycosis of jaw with multiple discharging sinuses.

through dust inhalation by men who follow grain threshing. The disease may also follow infection from an aspirated tooth or other foreign body—or by direct extension from neighboring organs.

Skin infection is rare and only through abrasion of skin does it take place.

PATHOLOGICAL FEATURES

While this organism shows its best growth in connective tissue and shows a predilection for connective tissue in its spread through the system, my findings do not agree with some authors in its being wholly limited in its growth to connective tissue alone. Cope does not believe extension to the peritoneum ever takes place. In one case in this series which came to autopsy the original site of infection was the appendix, and this patient showed multiple invasion of the peritoneal surface of the small bowel as well as extension to the liver, lungs, spleen and kidneys (Fig. 6).

It is practically certain that lymphatic metastases do not take place and this is a point in the differential diagnosis between tuberculosis and malignancy. There are cases recorded in the literature of pyæmic actinomycosis. George Dean reports such a case with actinomycotic endocarditis. Ponfick, in 1882, records two cases, also one of Israel's first cases was of pyæmic nature. These were all due to rupture of an abscess into a large vessel—a very rare occurrence. Otherwise extension of the disease occurs by continuity only. No tissue is immune to infiltration by it in its spread. Occasionally in the cervical region it may travel for considerable distance under skin and leave no signs of the disease in its wake. It invades bone either as a peripheral rarefying process, which is rare, or a central perforating type, which is more common in man. In liver, lungs, and spleen, it forms tubercle-like masses which coalesce to form larger degenerative areas which eventually break down in center. In subcutaneous tissues and fasciæ, it forms the typical hard, brawny, indurated growth which slowly undergoes a softening in the center as granulation tissue degenerates, and if not incised will in time break through the skin leaving a discharging sinus with a dusky, bluish discoloration around its margins. A characteristic of the larger sinuses is their tendency to granulation-tissue overgrowth at margins giving them a pouting appearance. This is often very marked in appendiceal forms, as shown in one of the cases in this series. Ulceration

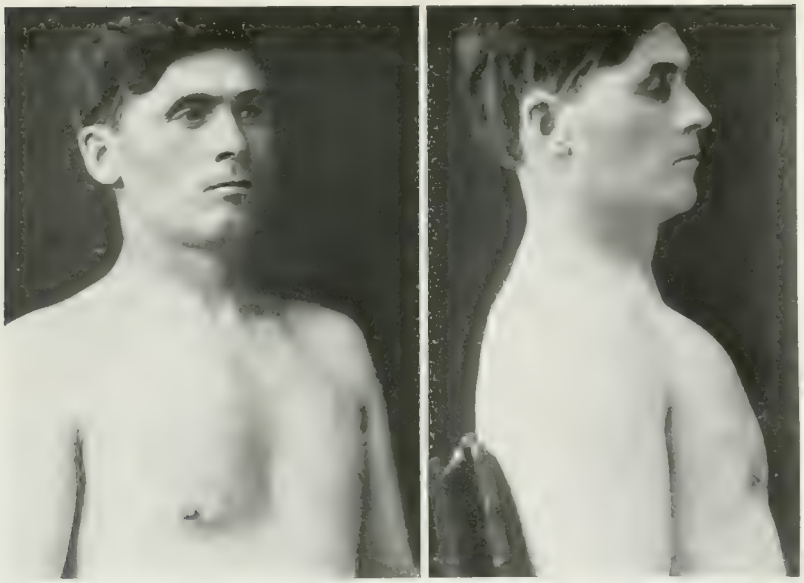

Fig. 4. Actinomycosis of lung with pleural and chest wall involvement as shown by bulging of right chest wall.

is seldom seen unless surgery has been attempted. Secondary infection always takes place as soon as opened up, which renders diagnosis very difficult. The discharge is seropurulent and contains the typical millet-seed bodies known as sulphur bodies. These are not always present unless the mass has reached a stage of softening. When cut into early, there is often nothing but a small amount of serum and a hard indurated mass of granulations obtained, instead of the expected pus. This frequently has led to erroneous diagnoses of malignancy in these cases. The sulphur body contains the fungus as a central mass of mycelium surrounded by the characteristic, ramate, clubbed bodies of the organism. It should always be looked for grossly in pus where disease is suspected.

CLINICAL COURSE AND SYMPTOMOLOGY

In the cervical and jaw cases there will frequently be a previous history of toothache with subsequent extraction of one or more teeth. On examining the oral cavity dental caries or pyorrhœa are found: a painless swelling in the region of the jaw or the neck develops. The swelling is usually circumscribed and is often mistaken for an enlarged gland. If not incised it usually breaks through the skin in time and discharges the typical seropurulent pus with sulphur bodies. If untreated other sinuses form and infection continues to spread into the subcutaneous tissue. A constant symptom in jaw cases is trismus. Likewise in appendiceal cases psoas spasm develops as soon as the infection burrows posteriorly involving the psoas muscle. The patient is never able to straighten his leg completely but keeps the thigh flexed on the abdomen to about ten or fifteen degrees. An erroneous diagnosis of tuberculosis of psoas muscle is often made on this account as in one of cases reported here. Appendiceal actinomycosis differs in no way from simple appendicitis. It may be acute, subacute, or chronic. The surgeon operates and removes the appendix and does not recognize the nature of the infection. In from 2 to 4 weeks an abscess may form either in the incision or at a point elsewhere. The incision is the most common site. The surgeon treats the abscess as a late wound infection and when the sinus persists, he suspects that a sponge has been left in the peritoneal cavity and frequently explores and finds nothing but an inflammatory mass

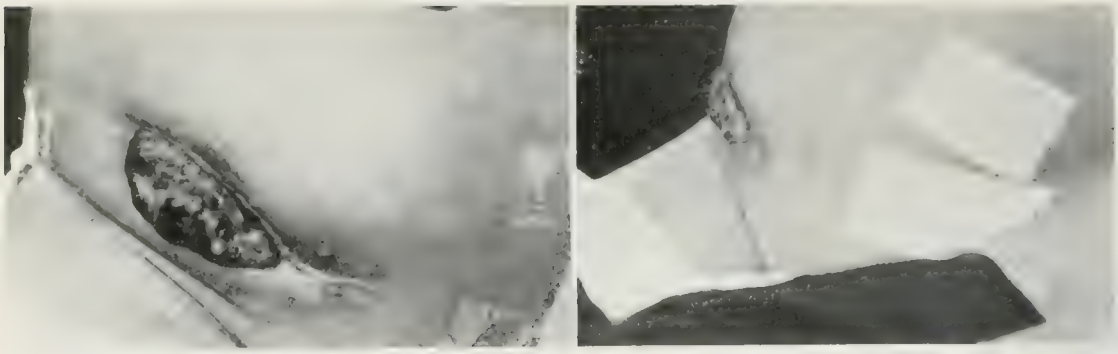

Fig. 5. Appendiceal actinomycosis showing typical pouting sinus in old McBurney incision. Front and side views.

at appendix site. This progresses until finally the entire right lower quadrant is filled with an inflammatory mass and a diagnosis of sarcoma is frequently made.

The pulmonary form of actinomycosis is very similar to active tuberculosis, lung abscess, or, if superficial, a catarrhal type of affection, a simple chronic bronchitis. Diagnosis is made by careful and painstaking repeated examinations of the sputum and a roentgenological study of the chest.

DIFFERENTIAL DIAGNOSIS

In the cervical region the disease is most often confused with tuberculosis, a diagnosis of suppurating tuberculous cervical adenitis frequently being made. The chief difference is the fact that this disease does not primarily involve the lymphatics and so soon as the incision is made and no suppurating or necrotic gland is found, the surgeon should be on his guard for actinomycosis. In this series of surgical cases two were found to be cases of actinomycosis which 10 years previously had been operated upon at the clinic and tissue diagnosed sarcomatous. It was only by chance in making a routine examination of the old slides for another condition that Dr. Broders found the fungus.

In the lung, actinomycosis is also often erroneously diagnosed as tuberculosis. A point of difference clinically is that actinomycosis does not begin at the apex. Careful sputum examination will as a rule show fungus in the sputum.

In the appendiceal region the disease is frequently diagnosed retroperitoneal sarcoma after tumor formation takes place. The previous history and associated sinus should put one on his guard for this disease. Likewise cases developing psoas spasm will not be diagnosed tuberculosis of the hip if this disease is kept in mind and the discharging sinuses investigated for the fungus.

PROGNOSIS

In neck and jaw cases, the prognosis is good. Of the 14 cervical and 7 jaw cases in this series, 12 reported themselves as entirely cured, 7 were improving but not entirely well. Skin cases, while stubborn, eventually clear up under vigorous treatment. The mortality in appendiceal cases was 100 per cent, all having died after being under treatment for 6 months to a year. The pulmonary form in this series was just as fatal as the appendiceal aside from the rare case of bronchial infection which was still living 20 years after infection took place, though patient was much annoyed by a chronic purulent bronchitis.

TREATMENT

This seems to be one disease in which potassium iodide is specific. Heroic doses, however, are necessary as even moderate doses do not produce results. The initial dose should not be less than 75 drops of the saturated solution, thrice daily, well diluted. This may be increased one drop daily until a maximum of 125 or 150 drops, three times daily, is reached. If symptoms of iodism intervene stop the drug for 3 or 4 days and then resume at the same dosage taken when

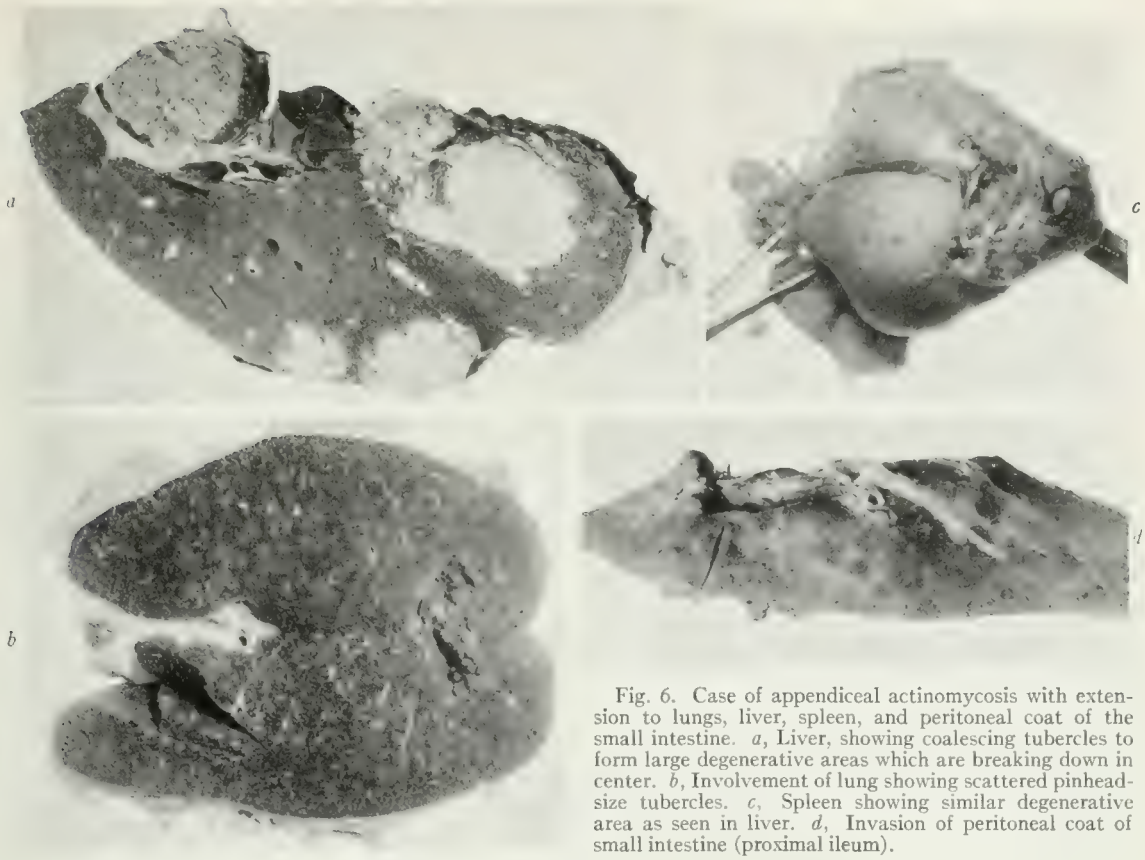

Fig. 6. Case of appendiceal actinomycosis with extension to lungs, liver, spleen, and peritoneal coat of the small intestine. *a*, Liver, showing coalescing tubercles to form large degenerative areas which are breaking down in center. *b*, Involvement of lung showing scattered pinhead-size tubercles. *c*, Spleen showing similar degenerative area as seen in liver. *d*, Invasion of peritoneal coat of small intestine (proximal ileum).

the drug was discontinued. By this method cases have taken as high as 150 drops three times a day eventually with excellent results and no untoward symptoms.

Surgery is of value only where the tissue involved can be widely excised. It was found of value in jaw and neck cases chiefly. The involved tissue was widely excised and the wound packed with iodinized gauze and kept open, with the hope of combating the anaerobic tendency of the parasite. While the surgical treatment no doubt hastened the cure in most cases, I do not believe it essential except where softening and abscess formation has taken place. The hard, inflammatory nodules before the stage of softening has been reached respond very well to potassium iodide alone as a rule.

A few of the cases were given $^1/_5$ grain copper sulphate, three times a day, internally, in addition to the iodide of potash. There was no noticeable increase in efficiency of the internal medication by this method and the cases given potassium iodide alone did fully as well. Local injections of pure carbolic acid has been reported of value in the literature but were not tried in this series of cases.

Radium and X-ray have been widely advocated as of value therapeutically. In our experience they were of value only as adjuncts to the surgical and medical treatment. Radium hastens the softening of the actinomycotic tissues in cases where the stage of softening has not yet been reached but it does not alone eradicate the parasite. Pulmonary and appendiceal cases were treated with radium and X-ray in addition to the internal administration of potassium iodide. While it was possible to arrest the disease to a certain extent the cases all proved fatal eventually.

Vaccines have been reported as of value but were not tried in this series of cases.

Space will not permit my reporting here in detail each of the cases included in this statistical study. Since leaving the Mayo Clinic, however, it has been my good fortune to have treated four more rather interesting cases of this supposedly rare disease. These cases are of special interest in view of the fact that three out of the four had previously been incorrectly diagnosed and were being treated for another condition, which is often the case in this disease.

Case 1. R. H., single, age 26; marine fireman. Family history reveals no tuberculosis or malignancy. Past history is negative aside from an occasional winter "cold." In March, 1918, an abscess of the neck was drained. In July, 1918, the submaxillary glands of the right side of the neck were dissected. Patient's chief complaint is discharging sinus of neck. In January about a year ago, patient first noticed a lump under right jaw. Four months previous to this he had had ulcerated teeth which ached almost constantly. He had four extracted, but the pain continued and 4 months after this a hard nodule developed below the angle of the right jaw. Trismus was never present. The nodule gradually softened, broke, and discharged. Patient saw a physician who incised the abscess and said it was possibly a tuberculous gland. The sinus persisted and patient saw another physician who diagnosed the disease tuberculous, cervical adenitis and did a submaxillary dissection of right cervical glands. The wound never healed completely and in 2 weeks it broke down and a sinus again formed and discharged. The sinus has continued constantly until the present time, with recurring nodules which have been lanced six times since the submaxillary dissection was done. No subjective symptoms are now present aside from the discharge.

Examination of patient showed a well-nourished adult male who seemed normal physically aside from the following findings. Both bicuspids and the anterior two molars were missing in the right lower jaw. The rest of the teeth were in fair repair. There was an indurated area on the right side of the neck, bluish-red in color, the size of a pecan, and with a discharging sinus in the middle. An old scar from a previous operation was seen just above.

A small curette was inserted in the sinus and typical "sulphur bodies" in serosanguinous pus flowed from the sinus. Microscopic examination showed a typical ray fungus.

Under local anæsthesia the indurated nodule was freely excised and the wound packed with iodinized gauze. Patient was given 75 drops of saturated solution of potassium iodide three times a day, the dosage being increased 1 drop daily until a maximum of 110 drops thrice daily was reached. By this time the wound had completely healed and to date he has remained entirely well.

I was at a loss to account for the source of the infection in view of the fact that patient's occupation was marine fireman. However, on further questioning he informed me that he had been in the habit of going to the harvest fields of eastern Washington every year for summer employment. He said he frequently chewed the raw grain while at work in the fields as he was very fond of it.

Case 2. M. N. K., married, age 56; farmers' store manager. Mother died of epithelioma of cheek. No family history of tuberculosis. In 1908, patient had appendectomy. He treated cow for lumpy jaw 20 years ago. One year ago he had an ulcerated tooth extracted. He was very fond of raw grain and chewed it frequently while in his store. He complained of a cough.

The cough began in July, 1919, and was dry, hacking, and became progressively more pronounced. He now coughs almost constantly and at times the paroxysms are quite severe. The appetite has failed recently, he has lost 16 pounds. The sputum became blood-streaked after the first month. In past few days patient has spit up rather firm nodular masses.

Examination showed a sick looking and rather dyspœnic man with a harrassing cough. Temperature 100.2°, pulse 90. Physical examination showed signs of consolidation in the right middle lobe. Except for loss of weight there is no other physical signs.

Roentgenogram of the chest showed condensation of the middle lobe of the right lung. A tentative diagnosis of a typical tuberculosis of the lung had been made. Sputum on examination had been reported negative for tuberculosis. Later sputum was examined again and showed the presence of the typical ray fungus.

Patient was given the usual dosage of potassium iodide together with massive dosages of radium and X-ray, but in spite of this fact he gradually lost ground and died within 6 months from the time of onset. He developed bone metastases before death.

Case 3. J. D., single, age 27; hostler at Remount Station, Camp Grant, Illinois. Family and past history was negative. Patient complained chiefly of swelling and stiffness of the jaw. The difficulty began about 6 weeks ago, with toothache. Patient had been employed as a hostler since his army service began 6 months ago. As far as he knows he has not come in contact with horses having chronic ulcers or tumors about the head or neck. He said he was frequently in the habit of chewing raw grain and picking his teeth with blades of grass and straw. He had had two left lower molars extracted just before the onset of his present trouble. The swelling and stiffness of the jaw developed 1 week later. The swelling was lanced but no pus was found. Poultices have been applied constantly for the past 3 or 4 days. The pain is constant and moderately severe.

Examination showed a well-developed negro who was physically normal except for the following findings. There was a hard, brawny swelling at the angle of the left lower jaw. Trismus was such that he could open the jaw only to admit lead pencil between the teeth. Slight fluctuation seemed to be present deep in the tissues. A probe was inserted in the old incision which caused a free flow of seropurulent material containing typical sulphur bodies. Patient was also given large doses of potassium iodide. He left my care before complete cure took place, so I am unable to report end-result.

Case 4. W. M., married, age 29; horseshoer. Family history negative. Past history negative aside from occasional attack of grippe. I saw this case postoperatively at the Army Hospital at Fort Riley, Kansas. Following a typical attack of acute appendicitis he had had appendectomy done December 1, 1917. A second operation for exploration of a sinus in the wound was done February 4, 1918. A third operation for exploration and drainage was done April 2, 1918. I saw him in May of this same year at which time he had a fixed, firm, irregular mass completely filling the right lower quadrant and extending up to the level of the umbilicus. There was marked psoas spasm on the right. The right leg could not be straightened beyond an angle of 170 degrees. I obtained the following report from his army record:

"Convalescence following appendectomy had been uneventful until 3 weeks following the operation when a hard mass formed at the lower angle of the wound. Hot fomentations were applied but it did not soften until 2 weeks later, at which time it was lanced and pus evacuated. Surgeon diagnosed it, stitch abscess. The wound kept draining, however, and on February 4, an exploration was performed for possible lost sponge. Nothing was found, except an abundance of adhesions and an indurated scar tissue at old appendix site. An iodoform gauze pack was inserted and the belly closed. Drainage continued and on April 2, a third operation was performed, at which time the sinus tract was excised. Since this last operation, a hard mass has gradually developed which at present fills the entire lower quadrant. Two discharging sinuses were present near McBurney's point. Six weeks ago there developed stiffness of the right hip which has remained in a constant state of partial flexion on abdomen. Patient is gradually losing weight and strength."

At this time a diagnosis of possible retroperitoneal sarcoma had been made by the surgeon. Examination of the discharge from the sinuses showed ray fungus infection to be present. I was interested in seeing the appendix which had been removed in this case and found upon exploring the tip a concretion the size of a small pea. On section of this concretion a piece of wheat grain was found in its center, proving without a doubt that this man had been infected directly through swallowing raw grain.

I was transferred to another post before treatment could be instituted so cannot give end-result.

CONCLUSIONS

1. There is but one true species of micro-organism capable of producing actinomycosis in man and lower animals and this is the one isolated by Wolff and Israel and later more fully described by Wright.

2. There is no convincing clinical evidence supporting the theory that this organism is a normal inhabitant of the oral cavity and gastro-intestinal tract of man.

3. There is much clinical and biological evidence that this micro-organism has its source outside of the human body and is capable of a dual existence: first as a saprophyte in old sod soil from which it gains access to grains and grasses and through this medium or intermediary host so to speak, it becomes capable of infecting man and lower animals.

4. In order for infection to take place two things are necessary: first, an abrasion of the tissues: second, the fungus must in some way be brought directly in contact with this abrasion.

5. Animal-to-man infection is far more common than we have been led to believe it was by earlier investigators.

6. Human actinomycosis is not a rare disease, but a disease which is often overlooked or incorrectly diagnosed.

7. Every inflammatory swelling of chronic or subacute nature with persistent and recurring sinus formation should be carefully investigated for this disease.

8. A negative smear, on first examination, does not rule out infection as the fungus, in the presence of mixed infection, is often very difficult to find.

9. The disease should always be kept in mind in every case of atypical pulmonary tuberculosis and should be looked for in cases suffering with chronic purulent bronchitis or bronchiectasis.

10. Early treatment of superficial lesions are highly successful. Internal infections are extremely fatal and hopeless.

I desire to express my thanks and appreciation to the Mayo Clinic for having had the opportunity of conducting this study, and for the help rendered by the statistical department of this institution.

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THE MANAGEMENT OF ACUTE CRANIAL INJURIES BY THE EARLY, EXACT DETERMINATION OF INTRACRANIAL PRESSURE, AND ITS RELIEF BY LUMBAR DRAINAGE[1]

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SURGERY is gradually overcoming obstacles to its employment in the various regions of the body as the advances in our knowledge of anatomy, physiology, and pathogenesis make the conditions for operation more clear. Thus history has shown how, in turn, the abdomen, the chest, the joints, and the head have been successfully invaded. The realm of *acute injuries* of the head, however, has been neglected by the surgeon. Advances in our knowledge of physiology and pathogenesis of acute brain lesions have not been utilized and procedures of diagnosis and treatment are today in a stage comparable to those employed for abdominal lesions of 30 years ago.

In this paper I shall endeavor to prove the following points regarding acute traumatic injuries of the brain.

Pathogenesis. The all important finding is that of *increased intracranial tension* due to œdema and hæmorrhage of the brain, causing interference with the paths of absorption of the cerebrospinal fluid. If not relieved early, the increased pressure leads to chronic morbid changes in the cortex of the brain, or in extreme cases, to death.

Symptoms. The symptoms usually depended on for indications to surgical interference, such as slow pulse, high blood pressure and stertorous respiration, are *late* symptoms and are due to *medullary* pressure. Surgery is of little avail if one waits until the medulla is involved.

Diagnosis. The early diagnosis of increased intracranial tension can be easily and directly made by estimating the pressure of the cerebrospinal fluid by the mercury manometer connected with the hollow needle inserted as for lumbar puncture. This increased pressure antedates the appearance of the secondary symptoms of medullary pressure by many hours.

Treatment. The relief of intracranial pressure can be obtained early and safely by repeated lumbar drainage. The relief so obtained prevents medullary compression and the symptoms usually looked upon as indications for operation do not appear.

Subtemporal decompression (supratentorial) does not adequately relieve pressure on the medulla (subtentorial), but lumbar drainage does relieve pressure on the medulla and suffices to prevent death; when the concomitant hæmorrhage and œdema of the brain has time to subside, the normal circulation of the cerebrospinal fluid is reestablished.

Realizing that the dicta cited above are somewhat revolutionary and are not in accord with present-day usage, I shall present evidence from a clinical study of one hundred cases of acute cranial injury and experimental evidence upon dogs in an attempt to establish their correctness. (The experimental work

[1] A report of experimental work done in the Department of Surgery, Northwestern University Medical School and Cook County Hospital, in conjunction with Prof. F. C. Becht of the Department of Pharmacology, Northwestern University Medical School.
Read before the Chicago Surgical Society, April, 1921

was done at Northwestern University in conjunction with Professor F. C. Becht).

HISTORICAL

Our data of the anatomy and physiology of the cerebrospinal fluid system are of comparatively recent acquisition and considerable yet remains to be discovered.

Eighty years ago, Majendie (1) discovered, in the roof of the fourth ventricle, the minute opening that bears his name and pointed out the connection between the cerebrospinal fluid in the ventricular system and that in the subarachnoid spaces of the brain and cord. By this epochal discovery he led the way to a correct understanding of the circulation of the cerebrospinal fluid and to problems associated with increased intracranial tension. Thirty-five years ago Corning (3), an American, tapped, for the first time, this cerebrospinal water-bed by inserting a needle between the last two spinous processes of the dorsal vertebræ, for the purpose of anæsthetizing the cord. Thirty years ago Wynter (4) drained the spinal system for tuberculous meningitis. It is to Quincke (5), however, that we owe our greatest knowledge of lumbar puncture and intracranial tension. In 1891 he published his studies on the diagnostic and therapeutic application of lumbar puncture and his work stands, after 30 years, as a perfect elucidation of the pathogenesis of lesions that affect the cerebrospinal fluid system. Quincke made it a rule always to *measure the pressure* of the cerebrospinal fluid by connecting the lumbar puncture needle with a fine glass pipette in which the fluid was allowed to rise. He found the normal pressure to be between 90 and 120 millimeters of water. Recently Weed (2) has shown how the cerebrospinal fluid finds its way from the foramina of Majendie and Luschka, through the subarachnoid spaces over the cortex of the brain to be absorbed mainly by the arachnoidal villi along the sinuses, especially the longitudinal sinus. I have found that any swelling or œdema of the cortex of the brain due to injury arrests the circulation of the cerebrospinal fluid and raises intracranial tension, ultimately endangering the medulla and floor of the fourth ventricle. Since Quincke's time a great amount of work has been done upon the acute and chronic forms of increased intracranial tension—such as occurs in hydrocephalus, brain tumors, uræmia, alcoholism, and the acute and chronic forms of meningitis. But the field of *acute traumatic injuries* has been neglected by the surgeon. In 90 per cent of the cases of acute cranial injuries—where there is subdural hæmorrhage or œdema—the patients are now treated expectantly by ice cap, catharsis, morphine, etc. Nothing accurately is determined as to intracranial pressure during their stay in the hospital or after leaving. Should they develop the late symptoms of medullary compression they are operated upon but too late for any hope of a successful outcome.

This state of affairs is partly to be explained by the work of Cushing (6) and others whose experiments seem to prove that the general blood pressure is an accurate index to intracranial tension. Following their line of thought, cases of brain injury are treated expectantly in practically all hospitals and no operative interference is called for until the general blood pressure reaches 170 or more and the pulse becomes slowed to 60 or less. No effort is made to determine the intracranial pressure by *direct* estimations, partly because the pulse, eye-ground and general blood-pressure findings are relied upon and partly because it is considered dangerous to perform lumbar puncture. I shall show by cases of my own and from reports of others that both these dicta are not to be relied upon for acute cranial injuries; that general blood pressure is low for many hours, due to shock, and that its rise is so slow in the cases that might be saved by operative interference that when it does occur, it is too late a finding to be of service. The danger of lumbar puncture in these acute traumatic cases has been greatly overestimated. Practically all of the sudden deaths following lumbar drainage have been in cases of chronic tension due to tumors, especially those below the tentorium cerebelli.

The technique of the exact determination of intracranial tension by the manometer has never been standardized. There has been

a lack of uniformity in reading results and in type of instrument used. Therefore, the procedure had fallen into disuse until Landon (7), sometime assistant to Frazier, in 1917, described a method of accurately determining the intracranial tension by a mercurial manometer and drew the attention of the profession to its importance in both medical and surgical conditions. He did not publish his results, however, by series of cases and little more was heard of the procedure until Sharpe (8) published his work last year on *Acute Brain Injuries*. Sharpe for the past 3 years following Landon's technique has based his indications for operation on the state of the intracranial tension as determined by lumbar puncture manometric readings, and by the examination of the eye-grounds. If the tension rises above 16 millimeters of mercury and the eye-grounds show beginning œdema, he performs a subtemporal decompression. He records results of a large series of cases.

Since my return from the Army I have been estimating the intracranial pressure in all my cases at the County Hospital and in private practice and present my results of a series of upward of 100 cases herewith.

Up to the present time the status of our management of acute cranial injuries is well outlined by Besley (9), who, in 1916, analyzed 1000 cases of fracture of the skull. He states that:

> The signs of general intracranial pressure produced by bleeding or œdema are usually present as manifested by unconsciousness, slow pulse, embarrassed respiration, high blood pressure, choked disc and vomiting. The advisability of making a lumbar puncture in all cases of suspected skull fracture comes into question. When blood is found in the cerebrospinal fluid it is highly presumptive evidence of the existence of a fracture. The procedure is by no means free from danger, especially in those cases in which there is a marked increased intracranial pressure. The danger is that, with the relief of pressure within the spinal canal, the medulla and pons may be forced into the foramen magnum and constricted sufficiently to cause immediate death. Therefore, it is not our routine practice to do spinal puncture in all cases. It is not done if the diagnosis can be made certain from other signs and symptoms. This procedure is reserved for that class of cases in which a patient is picked up on the street in coma and remains unconscious with no obtainable history of injury. If a positive diagnosis is not arrived at from other evidence a spinal puncture is done.

He then goes on to state: "It is surprising how infrequently the pulse rate is slow. The average is 96 in all cases, in only 65 of 1000 cases was the average below 70."

Furthermore, the respiration fails to show a striking characteristic change. There is vomiting in only 36 per cent. Vaughan, (10) moreover, has shown how little reliance can be placed on eye-ground changes in traumatic cases. Papillœdema is a late finding in intracranial tension. I have never been able to show an increase in general blood pressure early in these cases. In fact the patients are in shock for many hours after their accidents, with a rapid pulse and lowered blood pressure.

Rawling (11) in a study of cerebral œdema during the war states that blood pressure is affected but little. William Sharpe states that "the high intracranial pressure necessary to raise the general blood pressure to any appreciable extent must reach a very dangerous state of compression in these acute cases before its effects can be observed in an increased blood pressure. I feel, therefore, that the blood pressure as an important aid in the treatment of brain injuries has been much over emphasized." I might add that similar objections can be brought against the other symptoms and signs of acute intracranial tension. If, therefore, the symptoms and signs of increased intracranial tension, as increased blood pressure, slow pulse, vomiting, eye-ground changes of papillœdema, sterterous respiration, etc. are *delayed* evidences of intracranial tension that come on slowly and *indirectly* by pressure on the medulla, and are influenced by other factors such as shock and hæmorrhage and result often in blindness or death, is it not better to estimate the pressure early and directly before these dangerous symptoms arise? Especially so if the procedure is not fraught with danger. Granting, for the moment, that it would be dangerous to withdraw fluid in very high intracranial pressure, it is possible by a simple apparatus to estimate this pressure without the loss of a single drop of fluid by directly attaching the manometer to the

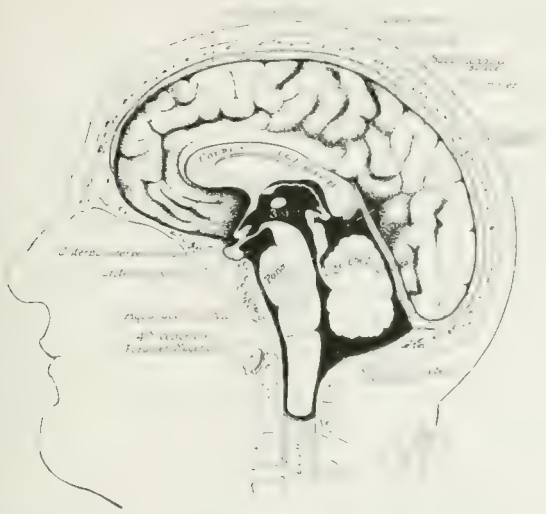


Fig. 1. The subarachnoid spaces in a median section of the head. Note the dilated basal cisterna and their free connection with the spinal subarachnoid space.

spinal needle. Kroenig (12) states that if the fluid pulsates it is in direct connection with the brain and fluid can be withdrawn without danger. If the pressure is high that is all we need to know. It may be from hæmorrhage or œdema; the indications are the same: Relieve this pressure by lumbar drainage and prevent papillœdema and pressure on the medulla. I do not agree, however, that the procedure is dangerous in the acute traumatic cases. This is an error that has crept into our calculations from results with cases of chronic tension, especially in tumor cases of the base of the brain.

Schoenbeck (13) in a recent review of deaths following lumbar drainage collected 71 cases and in 67 found by autopsy there was tumor or other chronic disease of the brain. Gumprecht (14) in 1900 collected 17 cases of sudden death following lumbar drainage, and autopsy showed them to be caused by pressure of tumor. Many of these were punctured in the sitting position and 15 to 60 cubic centimeters of fluid was withdrawn at one time. The accidents are due to pressure on the medulla by the walls of the foramen magnum and hæmorrhage from the tumors because of sudden release of tension on their vessels. The latter accident can also occur in decompression operations

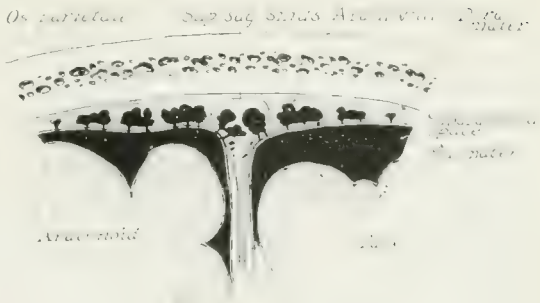


Fig. 2. Frontal section through the skull, meninges, and brain. Note the arachnoidal villi connecting the subarachnoid space with the dural sinus. (Modified from Key and Retzius.)

with sudden release of tension. On the other hand, I, or my assistants have done upward of 300 lumbar punctures in acute injuries to the head within the last year without untoward symptoms. Our patients are all in the horizontal position and usually not more than 10 to 20 cubic centimeters is slowly removed at one time.

Sharpe (15) has done 1100 lumbar punctures in the last 3 years with these precautions without a death. Kaliski (16) reports one death in over 10 years of this work and states that this could not be definitely attributed to the lumbar puncture. So I believe that we must take a different attitude toward these acute traumatic cases than we entertain toward the chronic cases where there is considerable molding of the brain by long-continued pressure.

In fact Kahler (17) is so impressed with this view that in a recent study he has tried to find some other factors responsible for deaths in cases of chronic cranial hypertension. His findings are that there is a rise of general blood pressure after lumbar puncture in cases of cerebral disease that may account for their sudden exitus. In those acute traumatic cases I have examined, the general blood pressure falls slightly immediately after lumbar puncture and would suggest lessened danger from that source. Kahler believes that estimation of the blood pressure, before and after lumbar puncture, is of considerable diagnostic significance in differentiating disease of the brain from other conditions, and can be used as a guide for the removal of fluid.

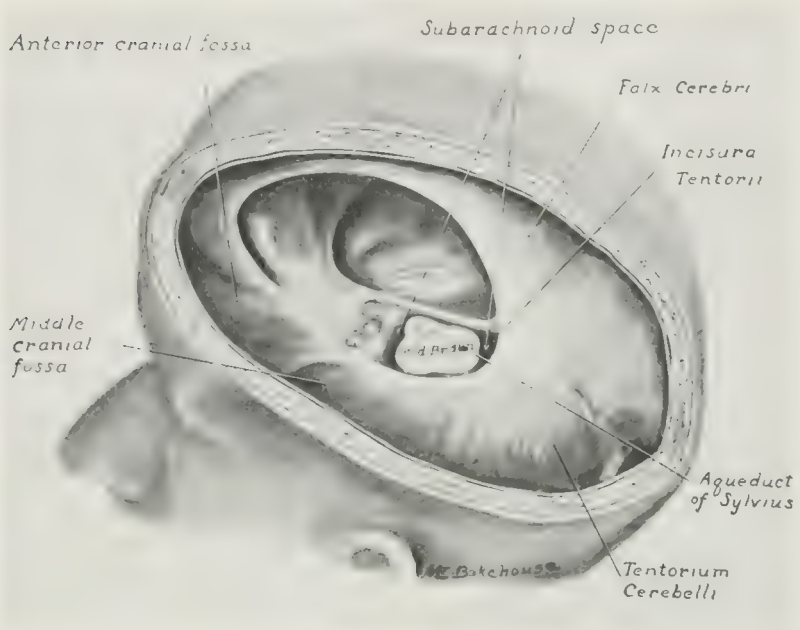


Fig. 3. Original drawing from a dissection of the skull at Northwestern University Medical School, showing the dural compartments above the level of the tentorium cerebelli. Note the isthmus of the tentorium cerebelli (incisura tentorii) and the narrow subarachnoidal space on either side of the mid-brain. This is the only connection between the subtentorial and supratentorial subarachnoid space. (Courtesy of Professor S. W. Ranson.)

ANATOMY AND PHYSIOLOGY

In order to understand the advantages that may be gained by lumbar puncture, it is necessary to have freshly in our minds the anatomy of the cerebrospinal water-bed. The cerebrospinal fluid is probably secreted in the ventricles by the choroid plexus. The lateral ventricles normally contain about 30 cubic centimeters. The fluid finds its way from the lateral ventricles through the foramina of Monro to the third ventricle, thence along the aqueduct of Sylvius to the fourth ventricle.

In the roof of the fourth ventricle posteriorly is the foramen of Majendie and in each lateral recess the foramen of Luschka through which the fluid escapes to the large cisterns beneath the arachnoid. These reservoirs have been named by Toldt according to their location. There are cisterns of the sylvian fissure, optic chiasm, interpeduncular space, pons, cerebellomedullary region and great vein of Galen. They contain normally about 60 cubic centimeters of fluid but in pathological states may contain two to three times this amount. Another 30 to 60 cubic centimeters is present in the spinal portion. The fluid rises through the incisura tentorii to be distributed over the cortex of the cerebrum. This is constantly being absorbed, mostly by the arachnoidal villi into the dural sinuses when there is no obstruction to its circulation. The total amount is renewed, as some believe, several times during the day, serving to dilute and carry off the metabolic waste products of the brain.

The cerebral and spinal subarachnoid systems are freely connected with each other, as was first demonstrated by Key and Retzius (18). This allows artificial drainage of the cerebral subarachnoid water-bed by the spinal route.

The circulation of the cerebrospinal system has always been rather vaguely described and surgeons generally have overlooked its importance. While some have realized the

importance of relieving the increased pressure of the cerebrospinal fluid, its metabolic function of carrying off waste matter has not been emphasized. The fluid after leaving the foramina of exit in the fourth ventricle finds its way upward from the basal cisterns through the narrow subarachnoid space of the incisura tentorii (Fig. 3) to the surface of the cerebrum, where it is absorbed for the most part into the dural sinuses and arachnoidal villi scattered over the surface of the brain. A slight swelling or hæmorrhage of the cerebrum or midbrain blocks the cerebral subarachnoid spaces and the fluid cannot be absorbed along its natural channels. The fluid no longer rises above the tentorium but collects in the basal cisterns and in the ventricles and stasis results. The enlargement of the basal cisterns forces the midbrain up and occludes further the narrow subarachnoid spaces in the incisura tentorii. The enlargement of the lateral ventricles above the tentorium forces the cortex of the brain still more against the dura and, unless the excess of fluid is withdrawn from below the tentorium, a dry and flattened cortex is found at autopsy. The medulla suffers from the direct pressure of the fluid in the basal cisterns which gives evidence by symptoms of vomiting, bradycardia, high blood pressure, and stertorous respiration.

Thus, we see a vicious circle set up—impeding the absorption of cerebrospinal fluid more and more until the resultant pressure rises so high that death results.

PATHOGENESIS

The tension of the cerebrospinal fluid may be increased in traumatic cases by a number of factors restricting the space usually occupied by cerebrospinal fluid:

1. Any depression of the skull, especially depressed skull fractures;
2. Hæmorrhage extradural—as in middle meningeal or sinus rupture;
3. Subdural hæmorrhage;
4. Subarachnoid hæmorrhage or œdema;
5. Subpial hæmorrhage or œdema;
6. Intracerebral, cerebellar, or spinal hæmorrhage or œdema;
7. Ventricular hæmorrhage;

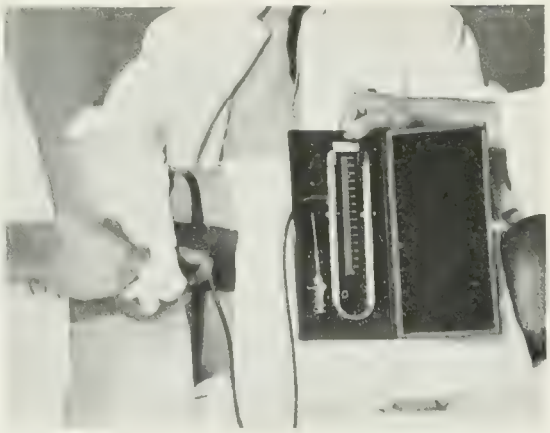
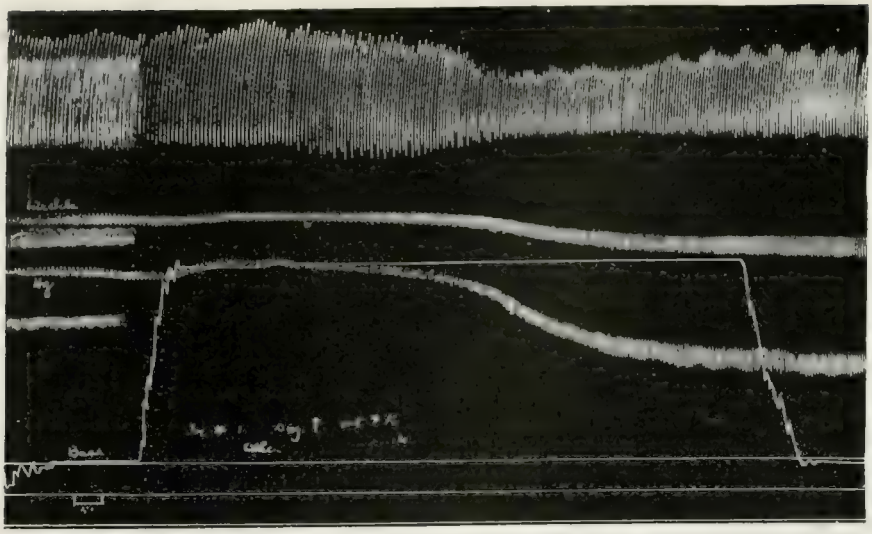


Fig. 4. Illustrating method of estimating intraspinal pressure with mercury manometer. Note the patient in horizontal position, needle in fourth lumbar interspace, and height of mercury column level with spine.

8. Increased secretion or decreased absorption of cerebrospinal fluid.

In depression of the skull and extradural hæmorrhages the pressure is usually localized and it is quite obvious that these conditions must be relieved locally by raising the depression and ligating the bleeding vessel. In the great majority of cases the other factors mentioned above come into play; the brain is pressed against the dura more or less, generally preventing the cerebrospinal fluid from reaching the arachnoidal villi to be absorbed. The secretion of fluid within the ventricles continues, however, so that within a short time, depending upon the extent of the cerebral œdema, the accumulation of fluid is so great at the base of the brain that the floor of the fourth ventricle and the medulla is endangered. The cerebral œdema sets up a vicious circle by cutting off the paths along which the cerebrospinal fluid is absorbed. This allows of a dilatation of the basal cisterns pushing up the mid-brain and blocking the isthmus of the tentorium cerebelli. This may explain the high pressures I have found after subtemporal decompression where the reading was taken by lumbar puncture. Le Count, in a review of the pathological lesions present after skull injury, found the brain pressed against the dura and the subarachnoid water-bed non-existent. The normal cisterns of the sulci were obliter-

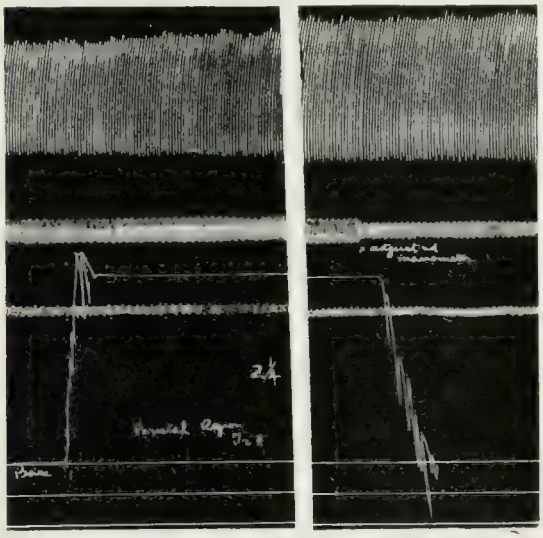


Graph 1. Intracranial pressure applied over medulla. Note primary stimulation of respiration, a slight rise in blood pressure, with the heart rate practically unaffected. Later, a decrease in respiration and fall in blood pressure and a marked slowing of the heart rate. Lastly, a return to normal when pressure is released.

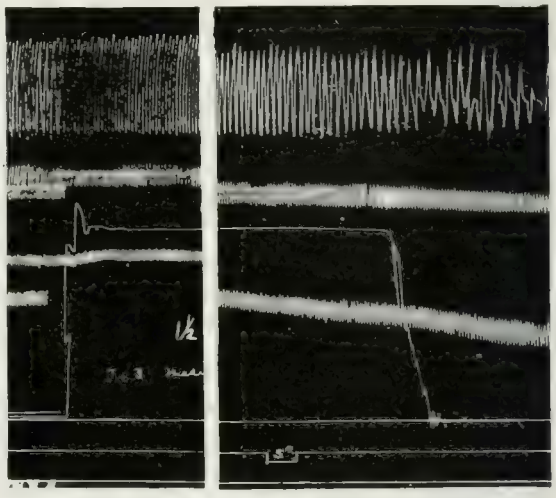
ated. Drainage above the tentorium is of little avail in these cases. It is my opinion that relief here can be obtained much better from below by lumbar puncture than by suboccipital or subtemporal decompression.

PATHOLOGY

Le Count (19) in an analysis of 547 cases of skull fracture that came to autopsy out of 908 cases collected from the records of the Cook County Hospital between 1911 and 1918 summarizes the chief pathological lesions as follows:



Graph 2. Pressure applied above the tentorium. There is no change in respiration, blood pressure or heart rate.



Graph 3. A repetition of the experiment shown in Graph 1 with identical results.

Twenty per cent are extradural hæmorrhages resulting from rupture of the middle meningeal artery—of these 63 per cent were not recognized clinically and of the 37 per cent recognized and operated on only 11 were saved, making the mortality of this condition 89 per cent.

In 95 per cent of all fractures there were subdural injuries. These consisted of subarachnoid or subpial hæmorrhages with a maximum of 100 grams of blood, the average being 40 grams and only 1 to 10 grams in 40 per cent of the cases. The subarachnoid hæmorrhage was due to bruises of the brain and rupture of the leptomeningeal vessels. The subpial hæmorrhage was from tears of subpial arteries. These were not so extensive as the subarachnoid hæmorrhages. It is quite evident that a considerable proportion of this blood can be removed by lumbar drainage.

The most frequent change in the brain found in persons dying from fracture of the skull was *traumatic œdema*. Here the convolutions were found flattened, suggesting *pressure of brain against dura and skull* and the *disappearance of the subarachnoid water-bed*. The cerebral vessels were empty and flattened suggesting an anæmia of the cortex. The peripheral ends of the sulci were closed—obliterating the normal cisterns of cerebrospinal fluid. The fluid in the leptomeninges was lessened and the visceral layer of the arachnoid almost dry when the dura was first removed. Then sweating occurred in the form of minute droplets on its surface.

Certain conclusions of great value from the standpoint of treatment may be drawn from these postmortem findings.

First, the almost constant finding of brain injury with hæmorrhage and œdema. This causes a swelling of the brain and restricts the size of the cerebrospinal spaces even to obliteration in severe cases. There can be no absorption of cerebrospinal fluid by the usual routes and with continued secretion of fluid within the ventricles there is added to the pressure created by blood clot and swollen brain that of unabsorbed cerebrospinal fluid in the basal cisterns. This increased pressure in the unexpandable cranial cavity is transmitted to the fluid in the spinal canal and can be measured by a mercury manometer attached to the lumbar puncture needle. We have in this way an accurate measure of pressure variation within the cerebrospinal system. For the actual destruction of brain tissue by trauma there is no remedy. We must, however, prevent any further destruction of the delicate brain cells by immediate relief of the pressure anæmia caused by the œdema and hæmorrhage.

Second. There is a simple method of relieving this increased pressure and of drawing off the effused blood. Through the direct connection of the spinal subarachnoid waterbed with the basal cisterns and ventricles, a needle inserted in the lumbar regions can relieve the pressure to any degree by measurement with the mercury manometer.

The only other logical method would be by suboccipital decompression—which is mutilating and unnecessary. Subtemporal decompression, as Cushing advises, does not afford relief to the medulla.

Third. The present classification of brain injuries into concussion, contusion, and compression is illogical. A better classification from the standpoint of surgical treatment should be based on *compression* alone; or better stated, increased intracranial tension, as there is very little of any true compression of the brain.

SYMPTOMS

The only sign of any value, early, is that of the cerebrospinal fluid tension as determined by the mercury manometer, and the presence of blood in the fluid. Confirmatory, would be the evidences of fracture by the X-ray. Paralyses indicate the localization of the lesion.

The symptoms usually relied upon—the slow pulse, embarrassed respiration, vomiting, and high blood pressure—are symptoms of medullary compression, endangering life and appearing too late for successful surgical interference. Papillœdema also appears late.

Quincke (20), in 1905, after many years of observation on the cerebrospinal fluid pressure, draws the following conclusions regarding symptoms:

"In acute brain injuries, the general symptoms often fail us. Moreover, in determining the *grade* of hypertension in acute injuries the general symptoms often fail us. It is in these cases that the *estimation of the cerebrospinal fluid pressure* is of most importance and the best results gotten by lumbar drainage. Acute serous meningitis, after concussion of the brain, often leads to chronic serous meningitis if not relieved. Chronic headaches, intolerance to alcohol, and neurasthenic symptoms often follow concussion with unrelieved hypertension."

It is only by the estimation of the pressure by the mercury manometer that one can make the diagnosis. We must realize that the slow pulse, embarrassed respiration, high blood pressure, choked disc, and vomiting are not the early signs and symptoms of increased intracranial pressure in the surgical sense, but are signs and symptoms of medullary compression, and it must be made very plain that once the medulla is endangered—the chances for life are very small indeed.

There is only one sure way of estimating increased intracranial tension before the medulla is affected by transmission of the pressure—and that is directly with the manometer. Who today waits for general signs or symptoms of increased blood pressure? Who still prides himself that he can estimate blood pressure by palpation of the radial artery? Who neglects today the use of the mercurial manometer in the exact estimation of blood pressure? Why, then, should our attitude toward cerebrospinal fluid pressure be any different? There are those who still count the drops per minute of the exuding spinal fluid or who measure the height with the eye to which the fluid spurts. The brain, unlike the heart or the abdominal contents, is a very delicate organ and withstands trauma but poorly. It is all the more important, therefore, that this organ be spared as much as possible long continued pressure. Watchful expectancy in cranial insult is criminal. The early and exact estimation of this deadly pressure and its early relief, if present to a harmful degree, should be our primal consideration. The surgical measures for this relief are at our hands and they should be executed in suitable cases as soon as possible. Theoretically, blood clot may so obstruct the cerebrospinal system that a spinal pressure reading may not be obtainable. I have never found this to be true in any of my cases; neither have I seen recurrence of cranial hæmorrhage after lumbar drainage.

DIAGNOSIS

Twenty per cent of the cases of head injury that come to autopsy present middle meningeal hæmorrhage which show an increasing pressure on the spinal water-bed with clear fluid—unless there is concomitant dural injury, in which case the fluid may be bloody. In subdural cases seen early, the diagnosis of brain injury—that is hæmorrhage and œdema — is made by repeated lumbar puncture—with the finding of blood, and an increased tension of the cerebrospinal fluid. The presence or absence of linear fracture is of secondary importance. The general symptoms of slow pulse, embarrassed respiration, increased blood pressure, papillœdema, and unconsciousness appear later if the increased tension is not relieved. They need not appear at all if tension is kept within normal limits by lumbar drainage. Focal symptoms help to localize the lesion of the brain.

PROGNOSIS

Variations in the manometric readings are the best guide to prognosis. Increasing pressures show that the lesion is progressing unfavorably. Decreasing pressures indicate a favorable outcome. Continued increased pressure indicates chronic hypertension, which, if not relieved, leads to symptoms usually classified as "traumatic neurosis," but are really evidences of a gliosis of the cortex.

TREATMENT

The expectant policy of most hospitals in acute brain injury has been superseded in my service at the Cook County Hospital by the following routine:

1. An examination of the head to determine site of injury and to rule out depressed fracture—first by inspection and direct palpation and later by X-ray.

2. Routine lumbar puncture. Take pulse and blood pressure before and after puncture. If blood is present in fluid and the pressure is high, withdraw 10 to 20 cubic centimeters

cerebrospinal fluid, determining the fall in pressure by special stopcock arrangement of needle attached to mercury manometer, and stop withdrawing fluid when pressure has been reduced one-half or to normal. If pressure reading is high and no blood is present in fluid, suspect middle meningeal hæmorrhage without rupture of dura.

Technique. Have patient on right or left side in *horizontal plane* and on an *unyielding* surface, with spine flexed—if necessary in a restless patient give a preliminary hypodermic of morphine or gas anæsthesia. Surgically cleanse area of fourth lumbar interspace and insert needle in mid-line. Withdraw stilet and as soon as cerebrospinal fluid appears, connect needle with mercury manometer held by assistant at level of spine and take reading. Then open side arm and collect cerebrospinal fluid in graduated sterile test tube. Shut off fluid when 10 to 20 cubic centimeters is collected or when pressure reaches normal, withdraw spinal needle and seal with collodion.

Description of instrument. The instrument is a simple U tube with side arm, made for me by Mueller & Company. Attached to the side arm is a rubber tube which connects readily with the lumen of the needle by a metal sleeve. The needle is 1 millimeter bore and has a horizontal stopcock which allows withdrawal of cerebrospinal fluid without disconnecting the manometer so that one can see the fall in mercury column while withdrawing fluid.

3. Treat shock, by usual methods.

4. Repeat lumbar puncture at intervals of 6 to 24 hours or longer, depending on height of pressure and rapidity with which pressure rises after withdrawal of fluid.

5. Other routine examination of the eye-grounds, reflexes, pulse, temperature, respiration, etc., to complete physical examination.

6. Keep patient in bed for 4 weeks in severe cases and take pressure reading before patient leaves the hospital to rule out any tendency to chronic hypertension.

In the non-fatal cases only those are tabulated where fairly complete records had been kept.

In all cases the blood pressure has been taken on successive days, both before and after lumbar puncture. It is usually between 100 and 150 systolic—low while the patient is in shock and slowly rising to what appears to be normal for the individual. In no cases of the series except one has it exceeded 170 systolic. In only 8 cases was it above 150. In 28 cases it was below 130. In those cases that showed a systolic pressure over 150, the patients entered after an interval or there was chronic hypertension due to systemic causes.

I have recorded the lowest pulse record on the accompanying charts. In 28 per cent of the cases, the pulse was below 60. In 50 per cent, the pulse was above 70. There seemed to be no slowing of the pulse or increase in blood pressure in those cases where the cerebrospinal fluid pressure is kept low by repeated lumbar drainage.

The eye-grounds were examined in most of the cases and in only three of the series was there papillœdema. The absence of papillœdema in most of the cases also was due to the repeated tappings of cerebrospinal fluid. The three that showed papillœdema were cases coming into the hospital several days after injury.

The cerebrospinal fluid pressure was above 30 millimeters mercury in 14 per cent, the highest reading being 60 millimeters. In 34 per cent, the pressure was between 20 and 30 millimeters. In 44 per cent, the pressure varied between 10 and 20 millimeters of mercury. In the fatal cases the pressure within the spinal canal varied between 12 and 60 millimeters. The mortality rate has been decreased from 50 to 25 per cent. A report on morbidity will be made after a sufficient interval has elapsed to be of value.

An analysis of our cases show that they fall into four general groups.

First, there are those cases of very severe crushing injuries of the head with medullary injury that succumb within a very few hours or at most 24 hours. With these very little can be done medically or surgically, and they constitute in this series of cases 13.3 per cent of the total number. The cerebrospinal fluid pressure varies between 12 millimeters and 60 millimeters of mercury.

ACUTE BRAIN INJURIES—SEVERE CASES

Case	Age	Injury produced by	Pulse	Symptoms	Blood pressure mm.	Cerebro-spinal fluid pressure mm.	Amount withdrawn c.cm.	Pressure afterward mm.	Fluid	Result
J. A.	55	Automobile	60	Coma, 5 days		12	10	8	Bloody	Recovery
						10	5	6	Yellow	
A. C.	28	Automobile	68	Coma	118-72	12	10	7	Bloody	Recovery
			64			9	5	5		
S. D.	64	Fall over railing	124	Coma. Bleeding from		18	20	8	Bloody	
			80	nose		14	10	6		
						10	5	6		Recovery
F. H.	31	Fall from truck	44	Coma. Later vomiting	168–80	20	15	8	Bloody	
			56		after-ward,	14	10	6		Recovery
					130 80	9	5	6		
T. H.	52	Drunken brawl	60	Comatose. Lacerated	120–86	6	10	4	Bloody	Recovery
			70	scalp	112–78					
F. D.	54	Motorcycle	80	Comatose, for 1 week.	165–118	20	30	7	Bloody	
	1st day		100	Fracture, left parietal	150–110	40	27	5	Bloody	
	4th d.		90	region Headaches.						
	8th d.		80	Talks intelligently	148–112	30	30	6	Clear	
	11th d		76	Rational, no headache	145–110	10	5	6	Clear	Recovery
J. I.	35	Fall down stairs	62	Coma. Bleeding from	120–75	17	10	10	Bloody	Improved
				right ear		12	10	6		
A. C.	40	Automobile	52	Coma. Bleeding nose	105 70	22	10	12	Bloody	
				and ear		16	10	8		
L. M.	42	Auto-truck	50	Coma. Paralysis right	125–85	40	20–30	10	Clear	Improved
			60	side of face. Head-ache		20	6	8	Clear	
						14	times	6	Clear	
C. S.	30	Freight car	54	Comatose	130 90	28	15	16	Bloody	Recovery (4 weeks)
			70	Headaches		24	10	14	Bloody	
			96			14	10	10	Clear	
S. D.	8	Auto-truck	110	Coma. Paralysis right	85-54	30	15	18	Bloody	Paralysis clearing.
				side. Loss of mem-ory. Irritability	83 56	22	15	14	Cloudy	
					88–58	8	10	6	Clear	Memory regained
C. F.	30	Slugged	50	Coma. Meningismus.	135–65	20	10	9	Bloody	Mentality
			60	Headaches	105–65	16	10	7	Bloody	clear
						12	10	6	Clear	Recovery
E. S.	13	Auto	88	X-ray. Transverse	104–44	20	10	8	Bloody	
	1st d.		100	Fracture frontal bone. Unconscious. Lacera-tion of scalp. Vomit-ing					in 3 tubes	
	4th d.		60 after puncture		122–80 after puncture	16	10	10	Blood tinged	Improved
			62		110–70					
	6th d.		60		110–80	12	10	4	Slightly tinged	Recovery
C. B.	45 10 days after injury	Auto	100	Coma, 2 days, bled from mouth	106–70 after puncture 114–86	22	15	6	Clear	Recovery
			Pulse 84 after puncture	Discoloration behind right ear, headaches		15	10	6		
M. S.	59	Fall downstairs	120 then 112	Temperature 103	150–80 then 132–70	12	15	7	Clear	Recovered from head injury. Died later of pros tatic abscess
G. M.	20	Riding motor cycle and collided with auto	68 68	Unconscious one hour	138–90 138 90	6	5		Clear	Recovery
F. H.			84 then 80		112–60 after 114–60	18 12	10 5	6 6	Bloody	Recovery
A. E.	36	Found on R. R. tracks 12 days before	80 80	Paralysis of ex. rect. of eye	150–84 142–80	18 16	15 10	8 7	Clear	Psychopathic
	45		90 90	Laceration of scalp concussion. Acute alcoholism	130–90 130–90	10	15	4		
F. S.	50		100 100	Laceration of scalp concussion	86–46 86–46	6	4		Clear	Recovery

ACUTE BRAIN INJURIES — SEVERE CASES — *Continued*

Case	Age	Injury produced by	Pulse	Symptoms	Blood pressure mm.	Cerebro-spinal fluid pressure mm.	Amount with-drawn c.cm.	Pressure after-ward mm.	Fluid	Result
S. F.	25	Fall off roof of moving train	68	Laceration of scalp, bleeding from nose	150–70 174–70	22	20	6	Bloody	
	1st d.									
	14th d.		80 then 90		130–80 132–80	40	15	18		
	17th d.		100		120–78	22	33	2		
			100		108–66					
	18th d.		Slight temperature	Decompression performed						
	19th d.		100		130–70	3	20	6		Discharged recovered
			90		128–70	13	10	6		
H. K.	60	Shot himself through frontal lobe	54	Unconsciousness Decompression, operation Ligated right middle men. artery drained sub-dural region	120–65 140–95	15 8	20	3	Bloody Clear	Recovery
E. W.	25	Fall from wagon striking back of head	72 84 76	Headache. Drowsiness Unconsciousness. Temperature 103. Mentality clear, no headache	150–105	13	8	5	Bloody	Recovery
										Recovery
M. Z.	29	Struck on front of head with club	48 56	Restless. Susp. skull fracture. Comatose. Beginning papillœdema, conscious, headache	150–90	30 18	18 16	18 16	Bloody Slightly bloody	
		2 days later	73		148–80	25	10	6	Yellow	
		10 days after injury	76 80	Mind clear, no headache		20	5	10	Clear	Improving
		20th day	72			10	3	7	Clear	Recovery
J. O.'C.	53	Blow on head with club	96	Aphasia. Laceration of scalp (left)	158–88	18	15	3	Clear	
	1st d.									
	2nd d.		84 60	X-ray shows linear fracture left parietal bone. Paresis of right arm. Talks a few words	158–88	24	20	4	Bloody in 3 tubes	
	5th d.		72 76	Slight headache	164–94	18	13	6	Bloody	
	8th d.		70	Returning use of hand. Temperature 101 F.		12	10	2	Yellow	
	18th d.		70							Recovery
S. H.	65	Auto?	80	Fracture right parietal bone Convulsions	140–75		5		Bloody	
			60	Bleeding from right ear. Irrational	176–90 150–78					Recovery
C. B.	40	Street car	100	Coma. Ecchymosis left eye. Left hemiplegia. Irrational	118–72	20	30	10	Slightly bloody	Psychopathic
	1st d.		88							
	2nd d.		60			10	10	4		
	3rd d.		52							
J. O.	23	Auto	80	Stuporous	125–75	10	5	10	Bloody	Recovery
O. S.	29	Found on sidewalk	80	Lacerated left eyelid. Stuporous 3 days	135–70	10	5	6	Bloody	Recovery
W. R.	65	Auto	100	Unconscious	150–90	25	10	15	Clear	
	1st d.		60	X-ray negative		22	10	10	Bloody	
	4th d.		72	Aphasia		12	5	6	Bloody	
	7th d.		100	Right pupil small						
	15th d.		80	Ecchymosis right eye		15	10	6	Yellow	
	25th d.		72	Clear mentally		15	10	6	Clear	
	35th d.		70	Speech returning		10	5	7	Clear	Recovery
M. S.	3	Auto	120–100	Laceration of scalp Skull fractured	110–90	18 12	10 7	8 6	Bloody	Recovery
W. B.	6	?	90 110	Skull fractured	114–60	22 14	10 10	10 6	Bloody	Recovery
F. d. M.	33	Street car	72	Coma. 17 days	150–70	20	20	10	Bloody	
	1st d.			Bleeding from nose,						
	2nd d.		62	mouth and left ear.	130–70	24	30	12	Bloody	
	3rd d.		56	X-ray showed fracture	125–76	28	30	14	Bloody	
	6th d.		68	left parietal.		18	20	8	Yellow	
	12th d.		72	Mentality clearing	125–75	8	10	5	Clear	
	18th d.		72		125–75	7	5	5	Clear	
	24th d.		72	Good condition	125–75	7				Recovery
C. G.	60	Fall from wagon	72	Comatose. Bleeding	128–85	10	20	6	Bloody	
	1st d.		60	from nose. Headache	100–100	12	20	6	Yellow	
	3rd d.		64	X-ray shows fracture		8	5	5	Clear	Recovery
	6th d.		76	of right parietal bone						
	14th d.									

ACUTE BRAIN INJURIES—MILD CASES

Case	Age	Injury caused by	Pulse	Symptoms	Blood pressure	Cerebro spinal fluid pressure mm.	Fluid	Result
J. S.	65	Fall from street car	60	Coma		10	Clear	Recovered left hospital third day
W. W	28	Fall in front of auto; alcoholism	108	Coma		8	Clear	Recovered left second day
T. S.	20	Fall from auto	90	Stuporous		8	Clear	Recovered left second day

CHRONIC OR CONTINUED HYPERTENSION

J. K.	27	Jack striking head	84	Headache Dizziness Vomiting	110 70	19	Clear	Recovered 10 c.cm. removed Symptoms relieved
J. W.	37	Axe striking head	74	Headaches Inability to work; depressed skull fractured		18	Clear	Unimproved

FATAL CASES

Case	Age	Injury produced by	Pulse	Symptoms	Blood pressure mm.	Cerebro-spinal fluid pressure mm.	Amount withdrawn c.cm.	Pressure afterward mm.	Fluid	Result
?	?	Skull fracture	100	Coma. Bleeding, left ear	?	15	10	3	Bloody	Death in 12 hours
T. S.	3½	Fall out of fourth story window	?	Fractured skull	?	13	?	?	Bloody	Death in 24 hours
H. B.	23	Hit on head with rock	58	Coma. Hæmorrhage from left ear and nose	100 80	26	20	14	Bloody	Death in 5 days
M. R.	50		100	Coma. Lacerated scalp Hæmorrhage left ear	90	10	5	2	Bloody	Death in 24 hours
F. J.	50	Fall downstairs	72	Coma. Skull fracture; temperature 103. Exophthalmus. Bilateral blurred discs	156	20	15	6	Bloody	Decompression Operation. Death in 12 hours
H. S.	60	Fall backward after a dizzy spell One week before entrance	66	Coma. One week. Skull fracture Chronic nephritis	195-110	40	30	10	Yellow	
	2nd day 4th day		64	Conscious. Headache	200-120	60	20	7	Yellow	Death
F. F.	30		56	Coma. Pupils unequal Exophthalmos	160-84	0	20	0	Bloody	Died 2 hours after entrance
F. A.	50	Street car	82 100	Comatose. Delirium tremens	128 80 118 72	22	10	6		Died of œdema of lungs

Second, there are those cases, rather common, of mild injury to the brain with unconsciousness—that show a normal or slightly increased cerebrospinal fluid pressure up to 12 millimeters and the absence of blood in the spinal fluid. These recover in 24 to 72 hours as a rule. Occasionally, one of them continues to have symptoms of headache, dizziness, and general symptoms of neurasthenia and develops a serous meningitis with increased intracranial tension. These are usually relieved by the repeated withdrawal of small amounts of cerebrospinal fluid. They constitute 26.6 per cent of the cases and there were no deaths.

Third, there are those cases of moderately severe cranial injury with or without skull fracture but with contusion of the brain There is blood in the spinal fluid and the pressure is increased beyond 12 and up to 22 millimeters of mercury, that is 2 or 3 times the normal pressure. There may be focal symptoms of paralysis of the extremities or of the face, or injury of the cranial nerves. The reflexes are altered. The temperature usually is increased and the coma or con-

vulsions persist for several days. It is here one's careful judgment comes into play. It is with this class of cases that I have achieved good results by carefully and slowly withdrawing from 10 to 20 cubic centimeters of fluid at intervals of 12 to 24 hours always watching the pressure of the cerebrospinal fluid so that it is decreased not more than one-half. Whether or not I am justified in this procedure, time alone can tell. The immediate results have been satisfactory. Sharpe advises subtemporal decompression in pressures over 16 millimeters. I believe this is not necessary. These constituted 42.2 per cent of the cases. The mortality in this group was 3 per cent.

The fourth class are those very severe injuries of the brain usually associated with skull fracture that show a cerebrospinal fluid pressure over 22 millimeters. Usually between 22 and 30 millimeters and sometimes as high as 40 millimeters. Here, a subtemporal decompression usually has been done. And yet, I am not convinced that subtemporal decompression does as much as lumbar drainage. They constitute 20 per cent of the total number and the death rate was 6 per cent; making a total death rate for the whole series of less than 25 per cent.

EXPERIMENTS

The following experiments were undertaken to determine the effects of pressure applied to the brain above and below the tentorium cerebelli. My thanks are due Prof. F. C. Becht of the Department of Pharmacology of Northwestern University Medical School for his kind co-operation.

In conducting these experiments on animals we recorded the blood pressure from the carotid artery, heart rate from the femoral vein and respiration from the side tumor in the respiratory tambour. A hole was drilled through the arch of the atlas and the dura incised so that the pressure could be applied directly to the medulla. A similar hole was drilled in the parieto-occipital region. Each hole was closed by screwing into it a brass tube. Both tubes were connected by means of a T-piece with a pressure reservoir filled with warm physiological salt solution. Clamps were adjusted so that pressure could be applied at will either over the medulla or over the temporoparietal region.

Graph 1 is a tracing secured from an animal weighing 9 kilos under ether anæsthesia. The top record is the respiration; the second shows the heart rate; the third the carotid blood pressure and the fourth the intracranial pressure. The lines at the bottom represent the signal and base lines of the graph. As can be seen from these tracings pressure applied over the medulla produces, first, a stimulation of respiration and a slight rise in blood pressure with the heart rate remaining practically unaffected. Second there is a decrease in respiration and fall in blood pressure and a marked slowing of the heart rate, changes which return practically to the normal when the pressure is released.

Graph 2 is a second tracing from the same animal in which pressure was applied to the brain in the temporoparietal region. The pressure applied is exactly the same as that applied in the tracing No. 1, but there is no change either in respiration, blood pressure, or heart rate.

Graph 3 is a repetition of the experiment shown in Tracing No. 1 and the results are practically identical there being first a slight rise in blood pressure, no change in heart rate and a slight stimulation of respiration followed by a decrease in respiration and slowing in heart rate and a falling in blood pressure. This graph shows that the failure of the change to appear in Tracing No. 2 is due to the difference in the application of the pressure and not to a decrease in the activity of the central nervous system.

These three graphs show clearly that the slowing of the heart rate and the change in blood pressure is a phenomenon of medullary compression, and therefore are likely to be a late manifestation of skull fracture where the injury lies in the central nervous system cephalad to the tentorium cerebelli.

CONCLUSIONS

The following conclusions may reasonably be deduced from observation of the clinical cases and from the experimental work on dogs.

1. In most acute injuries of the brain, the cerebrospinal fluid pressure is a fair index as to the severity of the lesion. Dependable prognosis can be made by any increase or decrease of this pressure.

2 A new clinical classification of injuries of the brain based upon cerebrospinal fluid pressure alone, as shown by the mercury manometer, is superior to the accepted classification of concussion, contusion, and compression.

3 The pathogenesis of acute injuries of the brain demonstrates that the principal effect of the œdema of the brain and hæmorrhage is to interfere with the absorption of cerebrospinal fluid by the usual paths; this sets up a vicious circle causing further pressure on the brain by the accumulating fluid in the basal cisterns below the tentorium cerebelli and in the lateral ventricles which presses the brain upward against the dura and produces cortical anæmia. The cortical anæmia, if unrelieved, quickly leads to gliosis causing lasting changes in the character, disposition, and mentality of the patient, if he recovers from the brain injury.

4. The relief of the increased pressure on the brain and the re-establishment of the normal path of absorption of the cerebrospinal fluid can be obtained by repeated lumbar drainage—which in acute injury cases is absolutely without danger.

5. Lumbar drainage is superior to subtemporal decompression in relieving pressure below the tentorium cerebelli and has the further advantage that it leaves no mutilating skull defect. The use of concentrated salt solutions intravenously lowers cerebrospinal tension but does not remove blood.

6. Experiments upon dogs, producing pressure on the cerebrum and on the medulla, show that the pulse, respiration, and blood pressure are affected only when the medulla is compressed. Therefore, to wait for these changes as an indication for operation on the cerebrum in acute cranial injury is to court disaster.

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AN ANALYSIS OF THE END-RESULTS IN TWO HUNDRED THIRTY-TWO HYSTEROMYOMECTOMIES

With Special Reference to Ovarian Conservation

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THE following is an analysis presenting the end-results obtained in a series of 232 patients upon whom supravaginal hysteromyomectomy was performed. The study was undertaken in the hope of shedding some light upon the fate of conserved ovaries, in cases in which hysterectomy was necessary and upon the ultimate comfort of such patients as compared with those from whom both ovaries had been removed. It is unnecessary here to consider in detail the many arguments for and against ovarian conservation in this class of patients. It has been asserted that conserved ovaries are likely to undergo cystic degeneration and give rise to pain; that they do not functionate, and, at best, that their life is ephemeral; that every conserved ovary is a potential factor for subsequent trouble; and that, in general, better results can be obtained by routine excision of these organs.

In our study only those cases in which the myoma was the principal pathological lesion were included, no patients who had passed the menopause at the time of operation being considered. Of the 232 cases studied, both ovaries were conserved in 90; 81 had one ovary removed; and in 61 a bilateral oophorectomy had been performed. Obviously patients who had recently been operated upon could not supply the desired information. For this reason only such cases as had been operated upon at least one year previously were utilized.

A questionnaire was sent to 374 patients. A considerable proportion could not be traced, as many of the patients had been operated on 5, 10, or even 13 or more years before. About 20 per cent of the patients included in this report have been interviewed personally and examined. A point to be noted is that the results obtained by the latter method are more favorable to ovarian conservation than are those obtained by the questionnaire. Patients will frequently answer one or more questions in a questionnaire in the negative because they attribute the symptoms from which they suffer to the operation or to the pelvic lesion, when, in fact, they are due to entirely different causes. Thus, in answer to a written inquiry, a patient may state that her general health is poor, a statement that may be true. Her poor health, however, may be due to a cardiac, renal, or other lesion entirely foreign to the condition that necessitated the operation.

In an investigation dealing with so complex a problem as the menopause, it is extremely difficult to formulate a questionnaire that will cover all points satisfactorily. Under such circumstances it is impossible, in many instances, correctly to interpret the cause of the symptoms and to determine with certainty whether they are due to the menopause or to some other condition.

This is exemplified by our inquiry regarding nervousness. Many patients answered this question in the affirmative, but it is evident that this symptom may be due to a variety of conditions, and is undoubtedly present in a considerable percentage of women who have never suffered from a pelvic lesion.

Nearly every symptom from which a woman may suffer as the result of an artificial menopause produced by a surgical operation may, if considered singly, be accounted for by conditions other than that of castration. It is only by a study of the combined symptoms—noting their time of onset in relation to the operation, their severity, and many other points—that a satisfactory conclusion can be arrived at.

The fact that the age at which the menopause occurs in the normal woman varies, and that it also differs markedly in severity in different individuals, adds materially to the difficulty in framing a questionnaire

such as ours. At the time of operation many of our cases were approaching the age at which the menopause should normally occur. This event would, therefore, probably have occurred, in a definite proportion of the cases, in the interval between the operation and the receipt of the questionnaire, even if no operation had been performed. For similar reasons a certain percentage of women would probably state that, during this period, they had suffered more or less severely from the menopause, even if no operation had been necessary. The personal equation also enters largely into the character of the answers obtained; thus some patients will complain greatly of a symptom that another will practically ignore. These and other sources of error should be taken into consideration in the study of these cases.

The effect of bilateral oophorectomy upon the sexual life of the woman is an important factor. This subject cannot be determined satisfactorily as the result of a questionnaire, and has not been referred to in our inquiry. Among the patients whom it has seemed feasible to question upon this point, quite divergent results have been found to exist. Viewed in the aggregate, and excluding certain perhaps exceptional cases, the results have been very decidedly in favor of ovarian conservation. The arresting of the sexual life, the senile changes, such as atrophy, drying, etc., that take place in the vagina, have been notably absent in those patients upon whom ovarian conservation has been practised. Atrophic changes in the vagina occur with such regularity following bilateral oophorectomy that we have made it a rule not to perform plastic operations for minor degrees of laceration upon patients in whom the removal of both ovaries is necessary. These conditions, and occasionally a mental attitude of inferiority or degradation, due to the patient's belief that she is unsexed, or in this respect senile, have been encountered in a certain number of patients in whom both ovaries have been excised.

Three important conclusions have been arrived at, namely: (1) That excellent end-results may be obtained by performing hysteromyomectomy, whether or not ovarian conservation is practised; (2) that the severity of symptoms occurring at the menopause is dependent more upon the patient's individual temperament than upon her age; and lastly (3) that conserved ovaries rarely give rise to trouble.

That excellent results may follow hysteromyomectomy, whether or not the ovaries are conserved, is well known, and is amply borne out by the fact that over 99.5 per cent of all our cases studied stated that they were either cured or improved by the operation.

Of the 212 patients who answered the question regarding their general health, only 2 stated that it was poor, and the family physician of one of these patients informed us that the ill health of his patient was due clearly to an advanced cardiac lesion. This patient had been operated upon 12 years previously, and no symptoms referable to the pelvis have occurred since the operation. No information regarding the condition of the other patient could be obtained.

The statement previously made, that the severity of symptoms attending the surgical menopause is dependent more upon the temperament of the patient than upon her age is difficult to prove by a statistical study. It has, however, been one of the most striking features of our investigation, and particularly emphasized in those patients who have been personally interviewed.

We have observed instances in which a bilateral oophorectomy has been performed upon young women, often still in their twenties, in whom, although the menopause has occurred, the attendant symptoms have been mild and given rise to little or no trouble. On the other hand, some of the most severe cases have occurred in women past 40 or 45 years of age. Unfortunately, even after a close study of the individual patient has been made, it is sometimes impossible to forecast just how troublesome the surgical menopause will be in her case. As a general rule, the highly strung, nervous or neurotic individual suffers most, whereas the phlegmatic asexual woman will experience little discomfort. Women differ markedly in this respect.

Reference has previously been made to the fact that the conserved ovary may undergo degenerative changes, and thus give rise to various distressing symptoms that may make a second operation necessary. This point has been emphasized by some operators, who therefore, recommend that a bilateral oophorectomy be performed whenever removal of the uterus becomes necessary. Our own experience does not bear out this finding. We firmly believe that too much stress has been laid on this point.

In the present series of 232 patients, ovarian conservation was practised upon 171 cases (in 90 cases both ovaries were conserved and in 81 an unilateral oophorectomy was performed) and 261 ovaries were spared. In not a single case was a second operation for the removal of the conserved ovary required. These figures furnish strong arguments for ovarian conservation, for if the retained ovary gives rise to no further symptoms, its removal cannot be recommended. Even granting that this series of cases may have been particularly fortunate in this respect, the evidence would certainly go to prove that the proportion of conserved ovaries that give rise to subsequent trouble is not great. We are firmly convinced that in patients who have not passed the menopause the ovary is a most important organ, and should not be removed unnecessarily.

We believe that successful ovarian conservation is largely dependent upon three factors:

1. *The ability of the surgeon to judge the condition of the ovary in situ.* It is plainly unwise to spare an ovary that is the seat of disease that will continue to progress after the uterus has been removed. Thus a severely inflamed ovary, or one the seat of a neoplasm, should be removed, whereas an ovary that merely presents a few adhesions, but that is otherwise normal, should be spared. It is only by considering the individual patient, and by careful correlation of the symptoms and the pathological process that is present, that accurate conclusions can be arrived at. An important guide in this respect is the amount of pain the patient has suffered prior to operation. Marked pain in the region of the ovary, or severe dysmenorrhœa, particularly of the ovarian type, is an indication for oophorectomy. Every operator should familiarize himself with the macroscopic and microscopic pathological changes that occur in the ovary. Without laboratory study, no surgeon is capable of judging pathological conditions *in situ*, and this is of the greatest importance in deciding whether or not to practise conservation in any given case.

2. *The maintenance of an adequate blood-supply for the conserved ovary.* This is of the utmost importance. If the character of the operation is such as materially to injure the blood supply of the ovary, conservation of the organ is hazardous, and subsequent trouble is prone to occur. The blood supply is less likely to be impaired if the fallopian tube is also conserved. In dealing with myomatous tumors of the uterus, this is usually a feasible procedure. In about one-third of all myomata that come to operation, the adnexa are inflamed, but the inflammatory process is more likely to be confined to one side than in either the gonococcal or the tuberculous varieties of salpingitis, and for this reason in the majority of cases, at least one normal tube and ovary are present. By practising conservation of the corresponding fallopian tube not only is a better blood supply secured for the ovary, but a more rapid and neater operation can be performed.

3. *The maintenance of the ovary in good position after operation.* If the conserved ovary is allowed to prolapse into Douglas' cul-de-sac or is twisted upon its pedicle in an attempt to suspend it, the blood supply is interfered with and painful symptoms are likely to develop.

It should be remembered that good results can undoubtedly be obtained by performing hysteromyomectomy with ablation of both ovaries, and for this reason a diseased ovary, or one in which the blood supply has obviously been interfered with, had best be removed. This, however, is not the condition that is present in the majority of these cases. It is our belief, that in the average case, there is no excuse for the removal of normal ovaries.

CONCLUSIONS

1. Hysteromyomectomy is productive of excellent end-results whether or not ovarian conservation is practised. Of all patients in our series, over 99.5 per cent were cured or improved, and over 83 per cent declared that their general health was good or improved one year or more after operation.

2. Better end-results and greater comfort to the patient can be secured as the result of ovarian conservation.

3. Everything being equal, better end-results follow the conservation of both ovaries than the retention of one, but one ovary is far better than none.

4. Conserved ovaries seldom give subsequent trouble. Among 171 cases in which ovarian conservation was practised, 261 ovaries were conserved, and in none of these patients was a second operation for the removal of the ovary necessary. This is a strong argument in favor of ovarian conservation in this class of cases, for if the conserved ovary does not give trouble, there can be no excuse for its removal.

5. That conserved ovaries may give subsequent trouble is conceded, as is also the fact that the series of cases quoted may have been unusually fortunate in this respect. Successful ovarian conservation depends upon the condition of the ovary at the time of operation, the maintenance of an adequate blood supply, and the retention of the ovary in its normal position.

6. We believe that undue emphasis has been placed upon the frequency of cystic and other forms of degeneration in conserved ovaries, and that attention to the points just mentioned will largely abrogate such disturbances.

7. Bearing in mind the fact that good results can be secured by performing bilateral oophorectomy, it is often better to sacrifice a doubtful ovary than to spare it. This is a point, however, on which each case must be judged individually.

8. When both ovaries are removed, the surgical menopause is by no means severe in all cases, those patients who suffer unduly being in the minority.

9. The age of the patient is not an unfailing criterion as to the severity of the surgical menopause in any given case. Young women will sometimes bear the loss of both ovaries well, whereas some of the most severe phenomena of the surgical menopause encountered in this series have occurred in patients past 40 years of age. This does not imply that the age is an unimportant factor in considering the question of ovarian conservation. Other things being equal, there is no doubt but that younger women suffer more severely as a result of a bilateral oophorectomy than do those who are older.

10. A more important guide than the age, however, is the temperament of the individual patient. The highly strung, neurotic woman is likely to suffer more severely than her more phlegmatic, asexual sister.

11. Each case should be individualized. The temperament of the patient should be studied, and a correlation of this with history and the pathological process found at operation should determine the type of operation to be performed.

12. Conserved ovaries functionate.

13. Even in those patients in whom the ovary does not functionate permanently, the occurrence of the surgical menopause is less abrupt and severe than in those women upon whom a bilateral oophorectomy has been performed. Among the former class of cases the artificial menopause generally resembles the normal menopause more closely than does that following the removal of both ovaries.

RELATIONSHIP BETWEEN HISTOLOGICAL STRUCTURE AND BIOLOGICAL ACTIVENESS OF GOITER TISSUE[1]

BY F. DE QUERVAIN, M.D., F.A.C.S. (HON.), BERNE, SWITZERLAND

UNTIL the end of the past century goiter was regarded as an entity in etiological research and no attention was paid to the histological structure of the gland in the individual case. Through the research work of Greenfield, Haemig, Askanazy, L. R. Mueller, and others, through our own investigation on thyroiditis, and, since 1910, through the work of Kocher and Howald, Plummer, Wilson, special cell changes have been noted in the goiter of Graves' disease, proving that the cell changes in the different types of goiter should be given due consideration.

In 1905 Aeschbacher, working under my direction, pointed out that results obtained could be interpreted only by means of combined chemical and histological investigation. He studied the material in our clinic, noting the relationship between the histology and the iodine and phosphorus content of the thyroid gland. The most extensive work in this direction has been done by Oswald and Plummer.

When biological methods began to be employed in studying thyroid function, there followed a demand for research work combining physiopathology and histology. Graham was the pioneer in this work. He tested the effects on tadpoles of the iodine contained in adenomatous tissue and normal tissue and found that with adenomatous tissue it was the same but less pronounced than with normal tissue. In either case it seemed to depend upon the amount of iodine in the tissue. On the other hand he was unable to determine a constant relationship between the physiological effect of the tumor substance, the percentage of iodine contained, and the histological character. Graham confined his research to adenomata. Wegelin and Abelin went farther. They investigated the biological effect on tadpoles and normal thyroid tissue and of thyroid tissue of different histological structures, from patients of different ages, also determining the amount of iodine the tissue contained. They came to the conclusion that the effect of struma diffusa, especially in its colloid form, and also of adenomatous goiter, resembles largely in many cases the effect produced by normal gland, with the exception of struma neonatorum which, as a rule, contains no iodine and has no specific effect.

This proves that growths which must be characterized as real tumors contain substances corresponding biologically to those in normal gland. But it has not been proved, as the authors themselves emphasize, that these substances are beneficial to the body. Neither do these experiments inform us in what quantity the substances enter into the circulation of the blood. Furthermore, as has been shown by Gley, substances which have been obtained experimentally from a gland may not, without reserve, be identified with the secretion of the gland.

We therefore decided to make a further investigation of our cases, examining, by means of the same biological method as used before, not only goitrous tissue but also venous blood from the thyroid gland and at the same time blood from any other large vein belonging to the systemic circulation, for instance, from a vein in the arm. These experiments were conducted in our laboratory by Dr. Hara. He used principally common goiter and the goiter of cretins.

Let me state here that the study of thyroid gland tissue and of blood by means of a biological method (Laewen-Trendelenburg method) has hitherto been made only once and then by Dr. Eiger at the Physiological Institute in Berne. His work covered seven cases of Graves' disease and two of common goiter, without considering the histological structure of the struma.

We did not use the thyroid tadpole and Laewen-Trendelenburg methods, but used a method worked out under the direction of Professor Asher by Dr. Streuli and Dr. Duran

[1] Presented before the Clinical Congress, October, 1921.

at the Physiological Institute in Berne. This method is based upon the observation that rats, when fed or injected with normal thyroid gland, become hypersensitive to a deficiency of oxygen. After being fed or injected with thyroid preparations, the rats are placed beside control rats under a bell jar attached to an air pump and are observed at different degrees of air rarefaction. Thyroidectomized rats bear the rarefied air longer than do healthy rats, while rats previously treated with thyroid preparations bear it less long. Careful attention to all the details of the experiment affords a more exact criterion for this senstiveness to oxygen than might be supposed.

In brief, the experiments were conducted as follows: Two rats were injected, one daily for 3 consecutive days with 2 cubic centimeters of blood serum taken from an arm vein, the other similarly with thyroid venous blood. A third was fed for 3 days with a total of 60 grams of tissue from the same struma. The experiments were made thirty-one times with blood from arm veins, thirty-one times with thyroid venous blood and thirty-six times with thyroid substances. Twenty-two common strumas, four Graves' strumas, and eight cretin strumas were subjected to examination. Among the common strumas there figured both strumata colloides diffusa and nodosa, and strumata parenchymatosa diffusa and nodosa. The cretin goiters were of the adenomatous type, in two cases with a slight colloid amount.

Before discussing the results of our experiments, a few remarks based on 30 years' study of the thyroid problem may be helpful.

RELATIONSHIP BETWEEN HISTOLOGY AND FUNCTION OF THYROID AS KNOWN TODAY

1. The epithelium of the thyroid gland produces a secretion called globular *colloid* which contains, in an albumin-like vehicle, colloid and crystalloid substances which are transmitted to the blood, perhaps also to the lymph vessels. Iodine plays an important part in the construction of the substances. There are also in the gland, substances which without containing iodine, manifest most important gland effects.

2. The epithelial cells of the thyroid gland also contain iodine and probably some part of the symptom producing substances, so that the iodine and such substances may be found in glands containing no colloid. Whether the epithelial cells supply the capillaries with these specific substances direct without taking the round-about way of the colloid, has not been solved even by means of either physiological or histological study.

3. The amount of colloid contained in the thyroid vesicles depends on the proportion between colloid production and colloid resorption. It represents, in a sense, the cash index, without permitting us to judge of the height of the output, i.e., the amount of colloid really produced by the thyroid gland. In the normal gland there is a regulating mechanism that may be called the "threshold of resorption," whereby the level of the colloid reserve in the gland is maintained. Every modification of this threshold, i.e. of the colloid stored in the gland, denotes a disturbance of eu-thyroidism. Such conditions are found—

a. At birth, when the newborn, deprived of the influence of the maternal thyroid, suddenly has a great need for thyroid secretion and the threshold temporarily sinks, leaving the reserve nil. In the course of a few weeks or months the threshold of resorption is re-established and is maintained during life until old age, when in consequence of less need for the secretion, it again sinks.

b. During adolescence and pregnancy, when greater demands are made on the gland.

c. During various acute illnesses, for instance, contagious diseases, intoxications, and burns, the threshold sinks, either because more colloid is required and its resorption is consequently accelerated, or because toxic changes in the gland cause a diminuation of colloid production.

4. The histological picture reveals the consistence of the colloid. We distinguish—

a. Thin liquid colloid, of net-like appearance, difficult to stain;

b. Thick liquid normal colloid, not, or only slightly vacuolized: usually eosinophilic, more rarely basophilic.

c. Old, thickened colloid, strongly basophilic, often laminated.

The first type is found in cases of Graves' disease, intoxications, and infections, the second in the normal thyroid gland and in colloid goiter, the third especially in cretin-goiters, and in senile thyroid glands.

The iodine index and biological effectiveness of the different forms vary also when the colloid appears similar. The capacity of the colloid for taking stain is nevertheless, in a general way, in a reversed relation to its physiological activeness.

5. The histological picture of the epithelial cells reveals the degree of activeness of the gland.

6. If the body is under normal thyroid influence, we speak of *eu-thyroidism*. If the body is constantly under increased thyroid influence, we speak of *hyperthyroidism*. The threshold of resorption may be normal, but is usually lower, and the "exchange" of colloid is increased.

If, on the contrary, there is a deficiency of thyroid secretion, we call the state hypothyroidism. In this case the threshold of resorption is usually also lower than normal as the gland contains little or no colloid. The "exchange" of colloid is decreased.

We will not go into the question, as to whether the causation of cretinism is exclusively due to disturbance of thyroid function, or whether the struma "noxe" has, in part, a direct injurious effect on the different organs. (Virchow-Bircher.)

The problem as to whether hyperthyroidism and hypothyroidism are due merely to a *plus* or *minus* or to a *qualitative* change in the secretion, has not yet been solved, either by biological and clinical researches or by histological facts.

Such a qualitative change, a "dysfunction," might be due to abnormal mingling of the various normal components of secretion (heterogenic or relative dysthyroidism), or to the origin of substances not occuring in normal secretion. (Genuine or absolute dysthyroidism.)

It is probable that pure hyper-and hypothyroidism, as well as hyper- and hypothyroidism associated with dysthyroidism, occur. According to Plummer and Wilson the "toxic adenoma" might produce a pure hyperthyroidism, while the true exophthalmic goiter might be the result of a state of dysthyroidism.

7. The histological structure of goiters varies according to the part of the country. In certain countries, especially in level regions, the diffuse colloid goiter, with and without hyperthyroidism, and the exophthalmic goiter predominate. In more mountainous countries the toxic goiter is an exception, and the nearer one approaches the center of the endemic area, the less he meets with the colloid goiter. It is replaced by the colloid-poor, diffuse, parenchymatous goiter in childhood and by the adenomatous parenchymatous nodular goiter with its degenerative forms in adults.

The cretin struma exhibits the gravest effects of the goiter-producing agent. Our own study of 50 such cases show that about nine-tenths of the strumas are quite, or for the most part, adenomatous with or without histological signs of activeness. The blood vessels are occasionally strongly developed, and among cretin strumas we meet with the most extensively vascularized adenomata that are to be found. As Bircher has already pointed out, cretin strumas contain thyroid substance which may not, as a matter of course, be considered incapable of thyroid function.

As regards the biological functions of the various types of goitrous tissue, we only know what the aforementioned experiments of Graham, Wegelin, and Abelin have taught us. The thyroid function of cretin strumas has not yet been investigated.

RESULTS OF EXPERIMENTS

The results of our researches and experiments on rats may be summarized as follows:

1. Feeding rats with *goitrous substance* always causes an increased sensitiveness to lack of oxygen. The strongest was found with exophthalmic goiters containing a little colloid, and then in decreasing order with non-toxic colloid goiter, general parenchymatous enlargement (adenomatosis according to Wilson) adenomatous goiters from non-cretins and the same from cretins.

2. The injection of *serum from thyroid veins* produced in all cases a positive reaction, but less strong than did thyroid feeding. The order of succession was the same. The blood from veins of common goiters is distinctly more active than that of cretin goiters.

3. *Blood from the arm veins* is distinctly active in the cases of colloid goiter and parenchymatous enlargement, but on the other hand not distinctly in cases of adenomatous goiters neither from noncretins nor from cretins.

4. In three out of four cases of dwarf cretins with *thyroid atrophy* (without goiter) the *blood from the arm* produced a decrease in the sensitiveness to lack of oxygen.

DISCUSSION OF RESULTS

We are not surprised at the great activity of the tissue from exophthalmic cases. The histological examination showed in all cases definite colloid contents. It is possible that the cases of exophthalmic goiter with less colloid would be less active than nontoxic colloid goiter.

It is obvious that the common struma diffusa colloids and parenchymatosa of noncretins, i.e., of individuals in a condition of eu-thyroidism, has about the same effect as the normal thyroid glands, as it plays the same part in the human organism. Seeing that in this case also, glands deficient in colloid are sometimes almost as effective as glands rich in colloid, we must assume with Graham, Wegelin and Abelin, that not only is colloid active, but that gland substance deficient in or without any colloid may contain much active substance.

It is eminently interesting that cretin strumas, such as occur in the worst cases of cretinism, are biologically active, even after every bit of nonadenomatous tissue has been removed.

The effectiveness of goiter substance does not, by any means, prove that its secretion is of benefit to the body. The blood experiment alone could give us information on this point.

As a result of the blood experiment we emphasize first that in the thyroid *vein* blood of every type of common struma the presence of active substance could be proved biologically. With the establishment of this fact one of the most important postulates of endocrinological research has been fulfilled. Of still greater importance is the fact that its activity can be proved, even if only in a very slight degree, in cases of highly developed cretinism.

Whether this effectiveness is due to the remnants of atrophic thyroid gland substance present in most cretins, or to adenomata, we can not directly decide. If however, we consider the positive results of feeding with adenomata taken from cretins, the histological signs of activeness in several cases and the rich supply of blood to these adenomata, we must assume it probable that cretin adenomata also might furnish active substances.

Certain facts in the endocrinology of cretins suggest that the active substance furnished by adenomata is not identical with the normal thyroid secretion. There is an outspoken dissociation of the main symptoms of cretinism. Dwarfism is more frequent in cases of atrophic thyroid than in cases of cretinism with goiter. Mental impairment may be slight in cases of dwarfism, and on the other hand very marked in cretins with goiters and without dwarfism. There is no parallel, indeed, between mental and skeletal disturbances.

These facts may be explained easily by the assumption that adenomata are able to furnish an active substance showing either absolutely abnormal qualities (absolute dysthyroidism) or abnormal proportions of the normal components of the thyroid secretions (relative dysthyroidisms).

One of the most important facts resulting from our researches, is the establishment of a *biological effect of arm vein blood derived from patients with common goiter* in contrast to the arm blood of non-goitrous people. Should these results be further confirmed, they would serve to demonstrate that the common goiter produces substances which are not destroyed in the small or large circulations and which affect a rat biologically about the same as thyroid secretion, even if the patient presents no signs of hyperthyroidism. These experimental results differ from those of Eiger who employed the Laewen-Trendelenburg method and found no activity, either in the arm vein blood of persons affected with Graves' dis-

ease, or in that of patients with common struma. Further experiments will throw light on this point.

Theoretically it would be very important if the results pertaining to the action on rats of blood from arm veins of non-goitrous cretins namely a *decreased* sensitiveness to lack of oxygen, could be confirmed. These results would tend to show that the thyroid gland possesses besides a stimulating action an antitoxic one.

Our researches are on the point of being completed by the study of the iodine and thyroxin action on cretins and by the comparison of the rat test with the tadpole test and basal metabolism.

It seems to me that the study of cretinism is equally as important in investigating the functions of the thyroid gland as the study of the exophthalmic goiter and that the rat test might be, in conjunction with the clinical and histological research, a valuable help toward the solving of the pending problems, especially in regard to the behavior of the blood and to biological activeness of the different types of goiter tissue.

ACUTE PULMONARY ŒDEMA IN LABOR

By FREDERICK G. CORBIN, M.D., C.M., Mendoza, Argentine Republic

TWENTY-FIVE years' practice and a search through textbooks and journals have not revealed a case similar to the one reported below. I feel justified, therefore, in presenting this report of a case of acute pulmonary œdema in labor for the consideration of my distinguished colleagues in this congress[1] of medicine.

Mrs. A. D. deS., age, 24; of German parents, married 7 years; of good social position; father, mother, sisters, and two brothers all living and well; does not remember being sick in her life. She had had one child 2 years after marriage. Labor was normal; the child strong and healthy, and never has been sick.

In the month of June, 1915, I was asked to attend patient in confinement in the city of Godoy Cruz, Mendoza. I was told that she had a good midwife and a competent German nurse and that only in case of unexpected complications would I have anything to do.

On accepting the case I asked for an analysis of a 24-hour specimen of urine. This was made by Dr. Munier. Two days afterward I again saw my patient in my consulting room. I must confess that, as I had known her for some 17 years, I did not make an examination; simply talked with her about her pregnancy and as the urine was pronounced normal, I assured her that there was nothing to do but to wait with patience and not to change in any way her mode of living

About the last of August I was called urgently and found the midwife in attendance. The midwife assured me that there was nothing — that the patient had had pains the night before but that these had ceased and there was no dilation of the uterine cervix. On examination I found this to be true and that the position of the child was normal. An analysis for albumin was made the following day with negative result.

One month later, at 7 a.m. on September 27, I was called again, arriving in company with the trained nurse about 8 a.m. The midwife told us that she had been called at 6, had found dilation, that the position was left occipito-anterior and everything quite normal. Trusting this diagnosis I did not even wash my hands, but sat down beside the patient and began to talk with her and advised her not to make so much voluntary effort as the involuntary forces were sufficient. In spite of this she persisted in making voluntary efforts to expel the child, but I do not think they were more than others use in the same conditions.

A few minutes after my arrival a fine, 3-kilo male child was born; a few minutes later the placenta was normally expelled without abnormal hæmorrhage. After congratulations I retired with the husband to the sitting room leaving in the hands of the nurse and midwife the care and cleanliness of my patient. On retiring from the bedroom not a single thing gave me even a remote idea of what was about to occur.

In about 10 minutes I was called by the nurse who said that the patient was very gravely ill. Her state was truly alarming; her general appearance gave one the idea of imminent death from asphyxia; her pale face covered with perspiration, her cyanotic lips, her nostrils dilating with each inspiration, her anxious expression, and feeble, almost imperceptible voice, all asked for air.

As can be imagined the moment was not propitious for counting respirations, while her pulse was

[1] National Medical Congress, Buenos Aires, 1916.

seventy-five, they must have been about fifty. The inco-ordination between pulse and respiration especially attracted my attention. I at once sat her up in bed and found on auscultation vesicular respiration and innumerable crepitant and subcrepitant râles throughout both lungs, while percussion was normal.

Diagnosis: acute pulmonary œdema.

While preparing an injection of morphine I ordered my two assistants to apply hot turpentine stupes to her chest and back. Her state was so bad that in spite of using boiling water and a good dose of the revulsive she apparently did not notice it. Five minutes after I had entered the room she had received 1½ centigrammes of morphine hypodermatically administered and in another 5 she began to cough at short intervals, while with each attack she brought up a mouthful of a frothy, bloody liquid. In the next half hour she had coughed up 700 grammes of this liquid and at the end of an hour this measured more than a litre.

This expectoration which at first was decidedly bloody, became rose colored and finally clear and crystalline. The pulse reached 100 and my patient was saved. In the afternoon the pulse was 90; no râles to be heard. An analysis of urine next day showed it to be normal. She got up 10 days after and nursed her son for over a year. Up to date she has never been sick.

This is the history of my patient and now let us say something of her disease.

I searched the literature for information regarding such cases and asked my colleagues of long practice regarding their experiences, but neither they nor any works obtainable in Spanish, French, or English could give me more than the following:

In the *Manual of Medicine*, published by Debove and Achard, 1896, is an article by M. Parmentier which mentions acute and general congestions of the lungs, and on page 190 gives among the causes "*des grande efforts surtout ceux de l'accouchment*"—this is all. Did M. Parmentier wish to signify an "acute pulmonary œdema?" I do not think so, because on page 196 he admirably describes an acute œdema and says it occurs in the gouty, arthritics, and Bright's disease, and does not mention pregnancy or labor as a cause. Through the kindness of a colleague I was able to read the thesis of Dr. E. Centenaro presented in 1908 before the Medical Faculty of the University of Buenos Aires "*Accidentes pulmonares durante el embarrazo*" (Pulmonary Accidents during Pregnancy). The paper is very interesting surely, but it refers to œdemata *not in labor* but before and caused by different intoxications.

Among the causes of this terrible disease, in the absence of renal, hepatic, cardiac, infectious disease, or medical intoxications, Albert cites "Purely mechanical causes," and I believe that my case was produced by "spasm of the left ventricle" (Huchard). Grossman says that it may be caused by a perturbation of the "innervation cardiopulmonary," and as a consequence of this a rapid "insufficiency of the right ventricle."

In my case it is impossible to attribute the attack to either the left or the right cardiac cavity but it was undoubtedly due to a spasm or cramp of one or the other; as in spite of careful examination of heart, kidneys and other organs no disease could be found; and again because had it been due to an intoxication as in the cases cited by Dr. Centenaro, the injection of morphine far from curing, would have made the patient worse.

Twenty years ago in Carmen de Patagones I saw an old woman who suffered from aortic disease with attacks of acute œdema. She experienced immediate relief and cure with a single injection of morphine with atropin. The treatment with morphine is very much discussed and while some authors consider it the most appropriate, others think that bleeding, stimulants, strychnine, camphorated oil, adrenalin, etc. are better. Some (Faisans, in Robins, 1912) even condemn the use of opium in any form. This is easily explained because the causes of acute œdema of the lungs are multiple and varied. Robins (1912) cites a long list of causes. My belief is that, as far as treatment goes, one should take only two causes into consideration: intoxication and heart trouble. These really include all the causes given by authors. I do not believe that an œdema, produced by intoxication, whatever may be the cause—whether it be faulty elimination of urea (renal), bile (hepatic), microbes (infectious disease) or poisons, etc.—requires different treatment; the result is the same, namely, toxic bodies circulating in the blood. What should be done? Certainly morphine should not be given. I believe that bleeding and

replacing the blood with physiological serum intravenously is indicated. The bleeding eliminates the poison and the serum dilutes it, while in such cases strychnine, caffein, and other stimulants will help the elimination by natural channels, and at the same time sustain the vital forces.

Let us now examine œdema produced by cardiac trouble — spasm or cramp of the ventricles, as Grossman and Huchard describe. The logical thing in these cases would be to give a dose of morphine and the illogical an injection of strychnine. The first ought to calm the spasm while the second might even produce it.

Apparently no one author has had opportunities to treat cases produced by more than one order of causes, as no one in speaking of the treatment has distinguished between œdema produced by intoxications and those caused by cardiac disease; with the result that some insist that the proper treatment is strychnine and others that it is morphine. The first criticizes the second and vice versa. My opinion is that as the cause in my case was cardiac (cramp) and not toxic, the correct treatment was morphine and it would have been better still if it had been associated with atropin.

This case and the old woman of Patagones, to whom I briefly referred with the same symptoms, treatment, and immediate results, although different as far as the provoking cause, are the only cases I have seen and to tell the truth have no desire to see others.

I reported my case in a paper in Spanish at the National Medical Congress in Buenos Aires, 1916, where it was discussed. At that time no one could recall a similar case.

As my patient again became pregnant and suffered attacks of œdema, finally succumbing to them, I feel inclined to publish the whole history.

Every few months from 1915 to 1920 I saw my patient and often examined her heart. I sent her to specialists in Buenos Aires and had both urine and blood examined several times. The Wassermann tests were negative. No one found anything pathological.

In 1919 she had influenza with severe congestion of lungs but no œdema.

In July, 1920, her husband came to consult me, telling me his wife was about 3 months pregnant and asking me if I thought there would be any danger in her having another labor. I told him I thought there might be and advised him to take her to Buenos Aires and consult the highest authority there, saying that I would be pleased to help in any way. He did so and consulted several professors showing them my address to the medical congress. One and all pronounced her perfectly healthy and laughed at the idea of future attacks or any danger. After a little over a month she came back bringing with her some tonic injections to be given by me intravenously. I never saw the prescription but believed them to have been *Enesol*.

Fortnightly I had her urine analyzed, and carefully examined her heart and blood pressure. She was very well through September and October; pulse between 90 and 100 while her blood pressure was from 90 to 110 milligrams mercury. Nothing abnormal was found in heart sounds. Only one thing was to be noted—a persistent and very great *fear* of an attack as before. She always insisted she would die in her labor. No one could *look* in better health.

In November she had her first attack; after sleeping quietly for an hour she awoke with dyspnœa. I was sent for at once and gave her an injection of one centigram of morphine with 0.5 milligram of atropin. The relief was immediate. She coughed up some 200 grams of rose-colored liquid and in 2 hours she was all right, getting up the next day without a sign of anything wrong. Her pulse when I arrived was 90, with blood pressure 120, and the next morning 100 with 105 milligrams mercury. She was now between 6 and 7 months pregnant; urine normal.

The question of producing premature labor was discussed, but as the effect of the morphine injections had been so good we decided to wait. I was fortunate enough to get Miss Ana M. Rabinovitz, a clever girl student in her last year of medicine, who had already passed her examinations in obstetrics; and installed her in my patient's house December 12. The following day Miss R. brought patient to my office where I carefully examined the thorax radioscopically and took a roentgenogram of the same. Later the plate was sent to specialists who also declared it normal.

Up to this date she had had two attacks more or less the same, both after sleeping quietly for an hour or more, both relieved at once by the same treatment. At midnight again on the 14th she had another attack, which was relieved by the same injection administered by Miss R. When I arrived half an hour later, my patient was still coughing and expelling bloody and frothy liquid, but was better. In another hour she was apparently well. Pulse next morning from 90 to 100 as in health. Temperature 36°C. Blood pressure 85 milligrams mercury. I prescribed 10 drops of digitalin daily for 5 days and on the 21st her blood pressure was 110

with urine normal. Every 4 or 5 days she would have a slight attack relieved at once with one half centigram of morphine with atropin.

On January 2, 1921, she went to bed early feeling very well but awoke a little after midnight complaining of palpitation. Miss R. gave her at her own request only a quarter centigram of morphine with atropin. On examining her lungs and finding fine râles all through them, with pulse 120 she gave her another quarter, say 5 minutes later. In about 10 minutes she had attacks of coughing with expectoration of liquid as on other occasions, but without the usual relief. In 10 minutes Miss R. gave another half centigram and on my arrival some 20 minutes later 1 centigram. Hot stupes to chest and shoulders which the patient gave us to understand were making her worse, were soon suspended. About 3 a.m. Dr. Day of Mendoza arrived in consultation, and later we tried oxygen and stimulants but without any effect; about 4 o'clock she became unconscious. For hours she had been coughing and expectorating mouthfuls of rose-colored fluid which finally drowned her. From mouth and nostrils this bloody froth continued to flow at each expiration. It was impossible to calculate the amount of liquid as from the first she insisted on using a handkerchief or towel. Judging from the amount expelled in her attack in 1915, it must have been at least 2 litres.

She died at 6 a.m., the heart beating a few minutes after respiration ceased. An autopsy was not allowed. In a similar case I would certainly produce an abortion at 1 or 2 months.

What was the cause of the pulmonary œdema? I believe cramp or spasm of one of the heart cavities.

I will conclude by referring my readers to *The Lancet* 1907, ii, and 1908, i, where they will find a number of articles on this subject; for a novelistic description of the attack and death from this disease to E. Zola's *Fecondite*.

A FURTHER REPORT ON TRAUMATIC FAT NECROSIS OF THE FEMALE BREAST AND ITS DIFFERENTIATION FROM CARCINOMA[1]

Three Additional Cases

By BURTON J. LEE, M.D., F.A.C.S. and FRANK E. ADAIR, M.D., New York

IN May, 1920, we presented to the American Surgical Association, clinical and pathological data upon the subject of traumatic fat necrosis of the female breast, with two case reports, pointing out the striking similarity of this disease to carcinoma. Since that report, we have encountered in the breast clinic at the Memorial Hospital three additional cases, and these have furnished some new evidence as to the incidence of the disease and its clinical behavior.

A careful search of the literature has revealed not a single reference, outside of our own experience, to this new interesting clinical entity. It has, however, been recognized by Dr. Bloodgood, of Baltimore, who in a verbal report to one of us stated that he had already noticed the lesion upon two occasions. One of his patients was diagnosed as a carcinoma of the breast and a complete radical operation performed. Pathological examination proved the case to be one of traumatic fat necrosis and not carcinoma.

Our former study has made it possible to render a correct pre-operative diagnosis in one of our three recent cases, this particular patient giving a marked simulation to carcinoma. The exactness of the traumatic history in this instance gave us at once a strong suspicion that the case was one of fat necrosis.

The two other patients presented many features suggesting malignancy, but the very sharply defined tumor caused us to render a pre-operative diagnosis of probably benign tumor. Traumatic fat necrosis, therefore, still remains closely allied, in its clinical phases, to carcinoma, but some variation in its behavior may suggest the possibility of a benign process.

We do not hesitate to admit that the clinical diagnosis may be difficult, even though the case may present a distinct traumatic history. The gross pathological picture is characteristic, but requires a pathological training, and the surgeon should have the complete co-operation of the pathologist, in the operating room, as well as in the laboratory, if the patient is to be spared an unnecessary radical amputation.

We are indebted to Dr. James Ewing, pathologist at the Memorial Hospital, for clearly outlining the important features of the gross and microscopical pathology. Our former report contained a full description of the pathological appearances of the disease and the three additional cases have served but to emphasize the characteristic picture therein described.

Concerning the difficulties of pathological diagnosis, Dr. Ewing has pointed out that the microscopic picture may be a difficult one to interpret if the diagnosis by frozen section alone is relied upon. Paraffin sections give a very much clearer microscopic picture.

The complete report of our first two cases has been detailed in a previous publication.[2] The three additional case reports follow:

Case 3. E.S., married, Russian, age 40, was admitted to the Memorial Hospital, June 10, 1920, having been referred to us by Dr. William B. Coley. Patient's chief complaint was tumor of the right breast. The family history was negative for carcinoma. Patient had had four children, all living and well. She had had no miscarriages. She had been operated upon by Dr. Coley, October 27, 1910, for a colloid goiter which showed areas of adenocarcinoma.

Mammary history. Had had four lactations, the first in 1914 and the last in 1917. During 1915 she developed an abscess in the left breast, which had to be incised. At the time of the thyroidectomy 10 years before it had been necessary to give a hypodermoclysis, which was applied beneath the right breast. *No hypodermoclysis had been applied to the left breast.*

[1]Read before the Surgical Section of the New York Academy of Medicine, October 7, 1921

[2]Traumatic fat necrosis of the female breast and its differentiation from carcinoma, with a report of two cases. Tr. Am. S. Ass., 1920, xxxviii, 294–313, also Ann. Surg., P., Au. 1920, lxxii, 188–195.

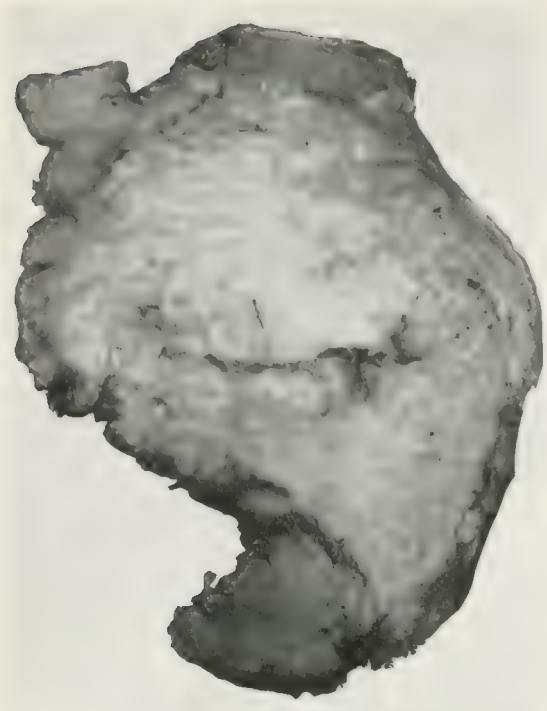


Fig. 1. Case 1. Traumatic fat necrosis. Gross appearance.

Almost four weeks ago a lump was noted in the right breast. It had not increased in size, had not been painful but had caused patient slight worry.

Physical examination revealed a short corpulent woman weighing about 200 pounds. The general physical examination was negative except for scar of thyroid operation. Wassermann was negative.

Breasts. Both breasts were markedly hypertrophied, hanging nearly to the level of the umbilicus. There were wide areas of areolar tissue about the nipples, and numerous dilated veins over the breasts. About 15 centimeters above the right nipple, lying immediately beneath the skin, but not fixed to it, was a tumor that was very hard, nodular, irregular in outline, measuring 8 by 6 centimeters. There was slight fixation to deeper structures. No nipple elevation or retraction were found, nor orange-skin appearance over the tumor. There had been no discharge from the nipple, and no enlargement of axillary or supraclavicular lymph nodes.

Provisional diagnosis: Benign tumor. Malignancy was considered improbable.

Operation was performed July 2, 1920. Ether anæsthesia was used. As it had been considered benign, a local removal of the tumor was made. On section of the excised mass, there were two or three cystic areas with walls very thick and firm, the largest of which measured 2½ by 2½ centimeters. The contents of the cystic cavities were of a semi-

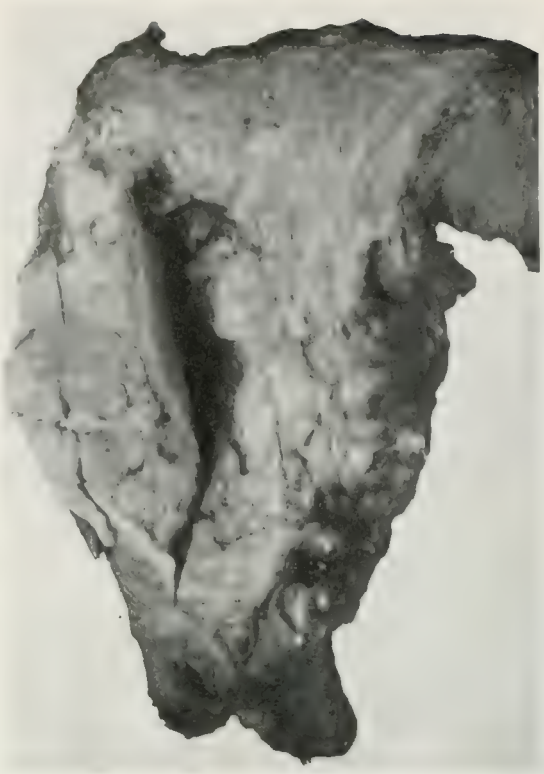


Fig. 2. Case 1. Traumatic fat necrosis. Gross appearance.

SUMMARY OF CASES

	Age	Weight	Trauma	Pain	Tumor hardness	Breast corpulent	Nipple retraction	Skin fixation	Deep attachment	Axillary nodes	Supraclavicular nodes	History visible hemorrhage	Patient noted duration	Pre-operative diagnosis
Case 1	52	190	Blow on breast 3 mos.	o	x	x	o	x	x	o	o	o	3 mos	CA
Case 2	30	211	Hypodermoclysis 7 mos.	o	x	x	o	x	o	x Soft	o	o	7 mos.	CA
Case 3	40	191	Hypodermoclysis 10 yrs.	o	x	x	o	o	x	o	o	o	1 mo.	Benign tumor
Case 4	47	152	Hypodermoclysis 10 mos.	x	x	x	x	x	o	o	o	x	10 mos.	Traum. fat necrosis
Case 5	54	180	Fell 13 steps striking post 8 yrs.	o	x	x	o	x?	o	o	o	x	3 wks.	Fibroadenoma

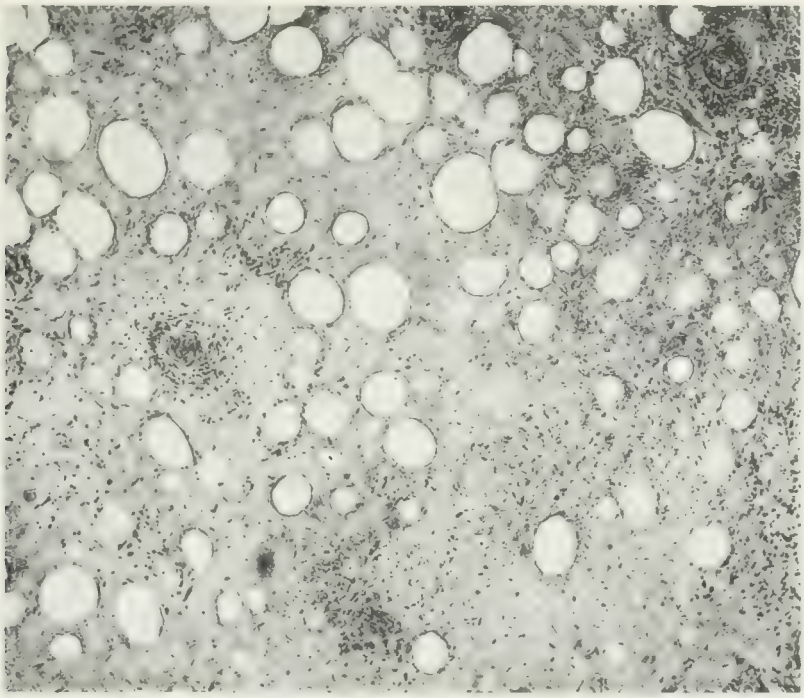


Fig. 3. Case 1. Microscopical appearance, showing endarteritis and peri arteritis; also fat cells and areas of necrosis.

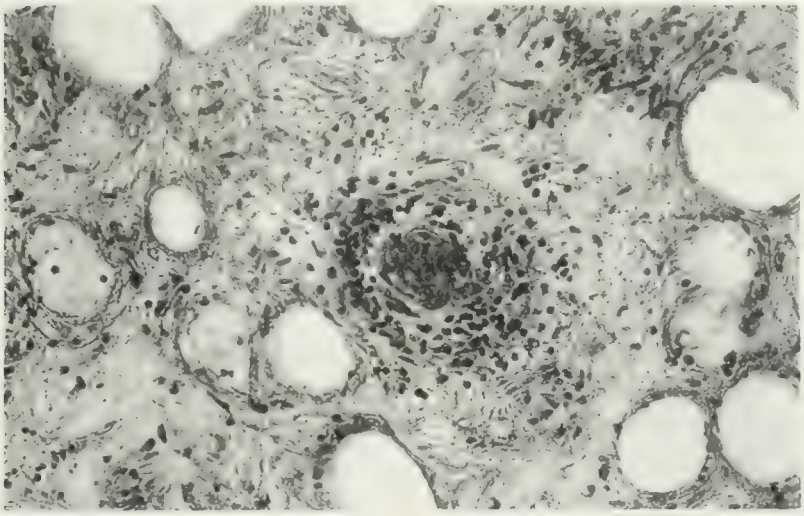


Fig. 4. Case 1. Microscopical appearance, showing enlarged view of Figure 3. This shows fat cells dividing and zone of saponification in many fat cells, also some necrosis.

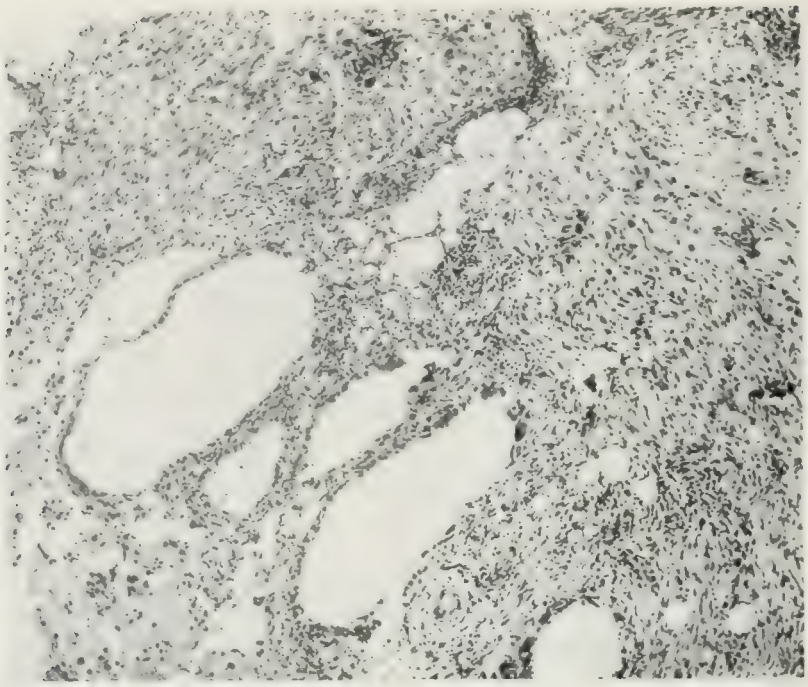


Fig. 5. Case 1. Microscopical appearance, showing productive inflammation and giant cells along tissue spaces containing liquefied fat.

fluid, granular material. The lining of the cyst wall was very irregular, rough, and shaggy, having a chocolate color. It seemed that it might be a degenerated papillary-cyst-adeno-carcinoma. With this diagnosis we proceeded to cauterize the wound edge and then did the radical operation for amputation of the breast.

Pathological report. Gross examination: The breast was very large and very fat. No definite islands of breast tissue could be seen. The excised tumor was 3 centimeters wide and presented a cyst with whitish hyaline capsules 1 millimeter thick. The contents were yellow, granular material, semi-fluid. Outside one-half the periphery of the cyst, the fat tissue appeared necrotic over an irregular area about 1 to 2 centimeters wide. No definite signs of carcinoma were present.

Microscopic examination: Section showed a thick, 2 millimeters laminated, hyaline, connective-tissue wall surrounding the softened cavity which contained necrotic fatty material. The breast tissue about this wall showed active productive inflammation with many round cells about the ducts of the breast, foci of lymphocytes, and new connective tissue. No characteristic signs of lues. No signs of tumor.

Case 4. M. F., married, age 47, was sent by her physician to the Memorial Hospital in October, 1920, "for advice as to radium and X-ray treatments for a breast tumor." Her chief complaint was tumor of the left breast. The family history was negative for cancer. Patient had always been well except for a tumor of the uterus which was operated upon 10 months before admission. Microscopic examination of the tumor had proved it to be a sarcoma.

Mammary history. Had one lactation in 1891 and another in 1895. Hypodermoclysis 10 months ago; otherwise negative.

During January, 1920, 10 months before coming under our observation, the patient was operated on at Atkinson Sanitorium, Jersey City, New Jersey, for what proved to be a malignant growth of the uterus. Due to the patient's condition, a hypodermoclysis was given under the left breast, and this was followed by a black and blue area which persisted for 4 weeks. During this period a hard lump developed in the breast and persisted until the date of admission, diminishing somewhat in size during this period. There were occasional pains and some slight tenderness in and about the left breast. During the 10 months' period radium had been applied three times, her physician taking it for granted that the breast tumor was malignant.

Physical examination revealed a well-developed and well-nourished woman who appeared to be in good health. General physical examination negative.

Breasts. Both breasts were full and adipose, but not pendulous. There was distinct asymmetry, the left breast being less rotund than the right. The left nipple was pulled downward 2 centimeters

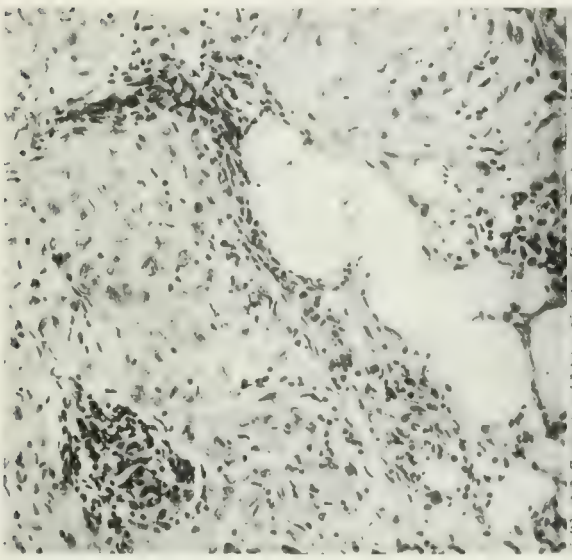


Fig. 6. Case 1. High power picture of Figure 5.

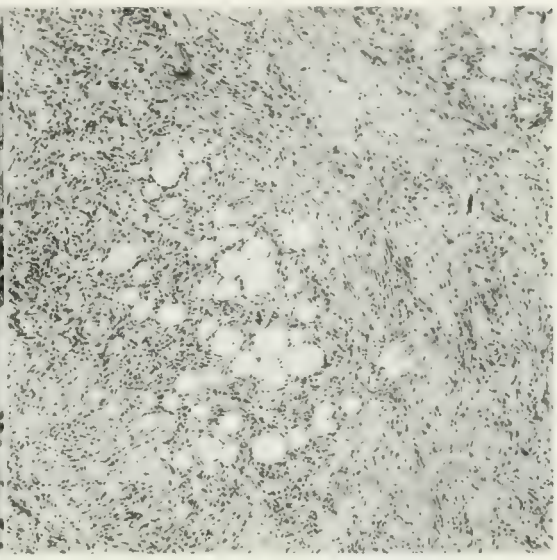


Fig. 7. Case 1. Microscopical appearance showing productive inflammation about fat cells.

below the level of the right. The left breast showed some "pigskin" appearance, and the veins over it were dilated, while this was not the case over the right. At the junction of the breast and the chest wall, toward 8 o'clock, there was a hard tumor measuring 6 by 4 centimeters showing slight skin adherence, but no attachment to deeper structures. The tumor was movable in breast tissues, nodulated, and so hard that to palpation it gave one the impression of carcinoma. No palpable axillary or supraclavicular nodes.

Provisional diagnosis: traumatic fat necrosis of left breast.

Procedure outlined: (1) X-ray plate of chest; (2) confirm the diagnosis of sarcoma of the uterus by asking the previous operator for a slide or report (in this our effort was futile); (3) cycle of X-ray treatments to breast and its regional areas; (4) photograph; (5) remove tumor under local anæsthesia. Confirm diagnosis, proceed to a radical amputation if the gross examination necessitates it.

Operation October 17, 1920. One-half per cent novocaine anæsthesia. An elliptical incision was made well outside the palpable limits of the tumor and the mass excised. On sectioning the tumor, it was diagnosed as traumatic fat necrosis, and the breast wound was sutured.

Pathological report. An area of breast tissue 4 by 5 centimeters was the seat of chronic productive inflammation with much new fibrous tissue, minute cavities, and streaks of opaque necrotic fat tissue. Section showed new acellular connective tissue; small foci of fluid fat surrounded by giant cells; foci of necrotic or structureless fat, and islands of normal gland tissue.

Case 5. G. R., married, age 54, was sent by her physician to the Memorial Hospital October 6, 1920, for diagnosis of a right breast tumor. The family history was negative for cancer. Patient had never had any serious illness. She has one child alive and well. No miscarriages. No uterine or ovarian disorders.

Mammary history. One lactation 36 years ago with a duration of 9 months, the child nursing both breasts. No history of abscesses or mastitis. No history of hypodermoclysis.

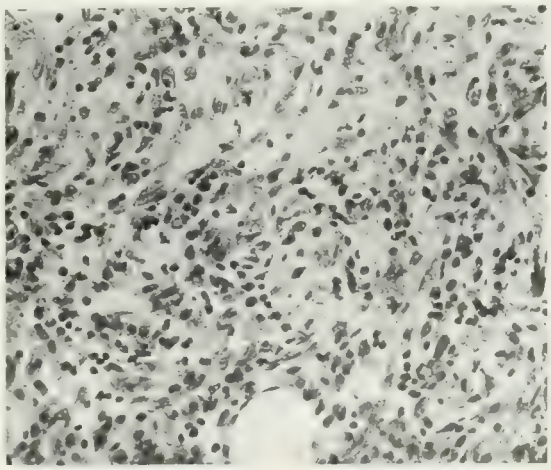


Fig. 8. Case 1. Microscopical appearance. High power picture of tissue in Fig. 7.

Fig. 9. Case 2. Traumatic fat necrosis. Cross appearance.

Eight years ago the patient fell 13 steps, striking the upper, inner quadrant of the right breast against the "point of the pedestal." The patient was a short, heavy woman weighing 180 pounds. The trauma was followed by a large area of ecchymosis, which gradually disappeared. Three weeks ago she accidentally noticed the presence of a lump in the upper, inner quadrant of the right breast. She thought that during this period the tumor had not grown appreciably. No pain or sensitiveness was present in the breast at any time.

Physical examination revealed a short, corpulent woman who appeared to enjoy excellent health. Her cheeks were quite red. Blood pressure 180, systolic. Weight 180 pounds. General physical examination negative.

Breasts. Large, full, and slightly pendulous. Left breast negative. In the upper, inner quadrant of the right breast situated 9 centimeters from the nipple toward 2 o'clock, was a firm, smooth, spherical tumor, measuring 2.5 centimeters in diameter. There was a suggestion of skin adherence over it, but no fixation to deeper structures. The tumor was movable in breast tissue. There was no nipple retraction, no "pig skin" appearance, and no discharge from the nipple. No palpable supraclavicular or axillary nodes.

Provisional diagnosis: fibro-adenoma or cyst-adenoma.

Procedure outlined: (1) X-ray plate of chest; (2) photograph; (3) a pre-operative series of five X-ray

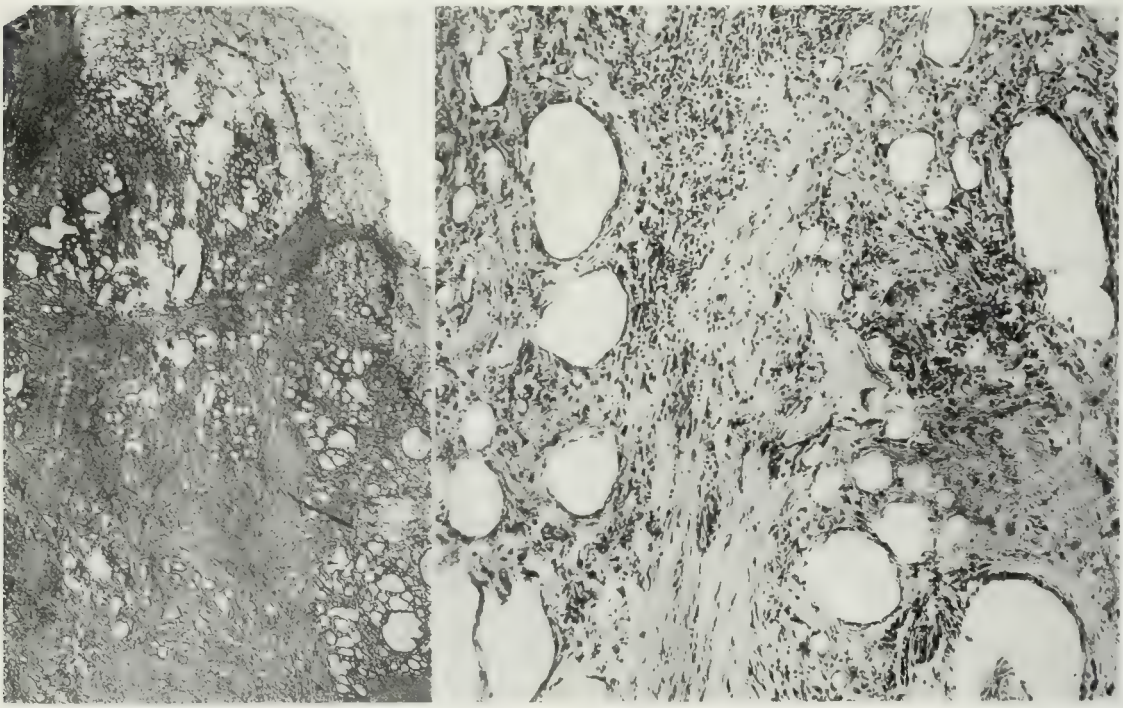


Fig. 10 (at left). Case 2. Microscopical appearance showing new connective-tissue production about spaces containing fluid fat.

Fig. 11. Case 2. Microscopical appearance showing giant cells growing about tissue spaces containing diffluent fat. Also new connective-tissue production.

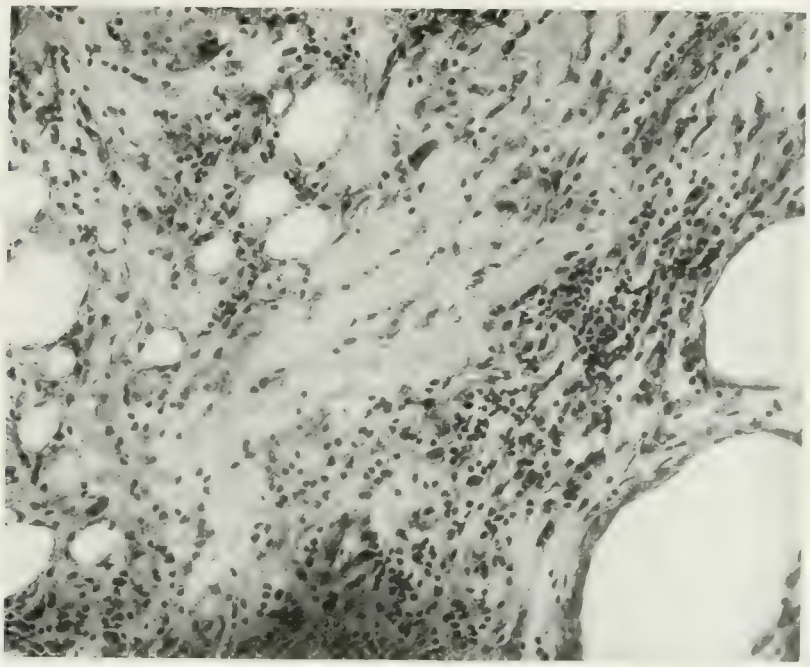


Fig. 12. Case 2. Microscopical appearance. High power of Figure 11.

treatments to be applied over the tumor and breast; (4) local removal of the tumor under novocaine anæsthesia; (5) If necessary a radical amputation, should examination of the excised tumor require it.

Operation. December 11, 1920. One per cent novacaine anæsthesia. Excision of stony tumor 2.5 centimeters in diameter. Examination of the mass showed that the wall of the tumor was 0.75 millimeters in thickness and appeared to be calcified, while the cut section was of unusual appearance and hardness. In the center of the tumor was a small cyst 1 centimeter in diameter, containing a dirty, yellowish-brown, thick, fluid. Positive appearances of carcinoma were lacking, so nothing further was done at operation. Suture of breast wound.

Pathological report. Section showed chronic productive inflammation in fat tissue. There was a small central cavity filled with semi-fluid, fatty material, about which were many similar small cavities around which giant cells were forming.

INCIDENCE

During the period in which these patients have presented themselves at the breast clinic, we have also encountered 120 cases of primary operable and 163 of primary inoperable breast carcinomata. Traumatic fat necrosis of the breast, in comparison with primary breast carcinomata has occurred in the proportion of 5 to 283, or 1.8 per cent. The occurrence of fat necrosis in comparison to primary operable carcinomata is as 5 to 120, or 4.2 per cent. Among our benign breast tumors the proportion of fat necrosis to other benign lesions is as 5 to 72, or approximately 7 per cent. Cases of fat necrosis, therefore, are not rare.

AGE

All examples of the disease have occurred at the age when cancer was to be expected. The youngest patient was 36, the oldest 54.

CORPULENCY

This seems to be an important factor. In this series there was not one thin individual and every patient had more than the average amount of subcutaneous tissue. All were heavy women, none weighing under 152 pounds, while the most corpulent weighed 211 pounds. The disease, therefore, apparently occurs in patients whose subcutaneous fat deposits are above the average.

CORPULENT BREASTS

In every instance the breasts were large and full. In one individual the mammary glands reached to the level of the umbilicus.

Fig. 13. Case 3. Traumatic fat necrosis right breast. Note corpulency.

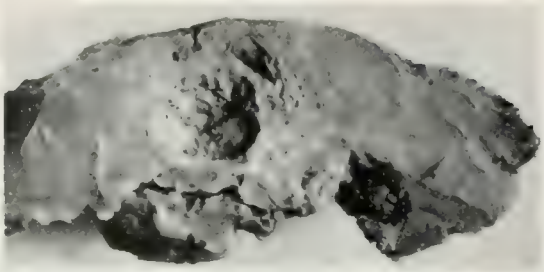
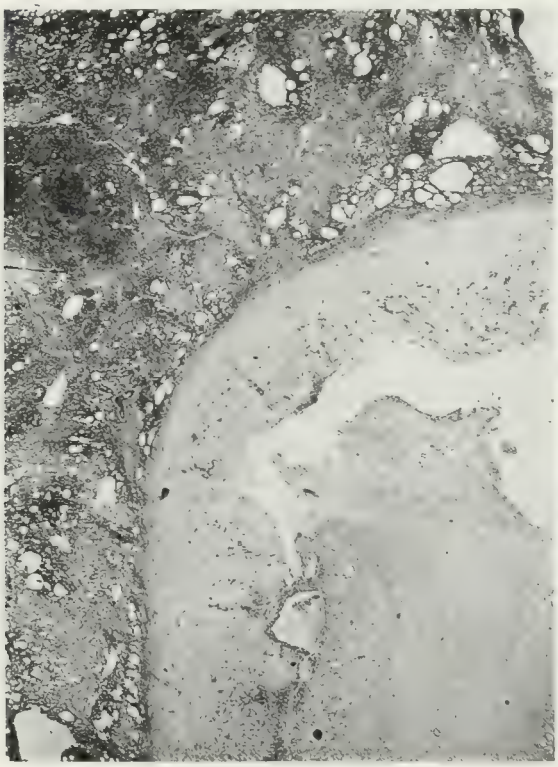


Fig. 14. Case 3. Traumatic fat necrosis. Gross lesion. Outer areas inflammatory fat tissue. Very firm wall. Necrotic center roughened and papillary in areas

TRAUMA

One of the chief diagnostic points is a *bona fide*, accurate history of trauma. Great care should be taken by the surgeon to assure himself that the site of injury coincides with the location of the fat necrosis. Unfortunately, although a history of trauma is too easily obtainable from patients suffering with breast carcinoma, it is frequently indefinite and inaccurate.

Case 1 received a severe blow upon the breast delivered by the sharp point of an elbow.



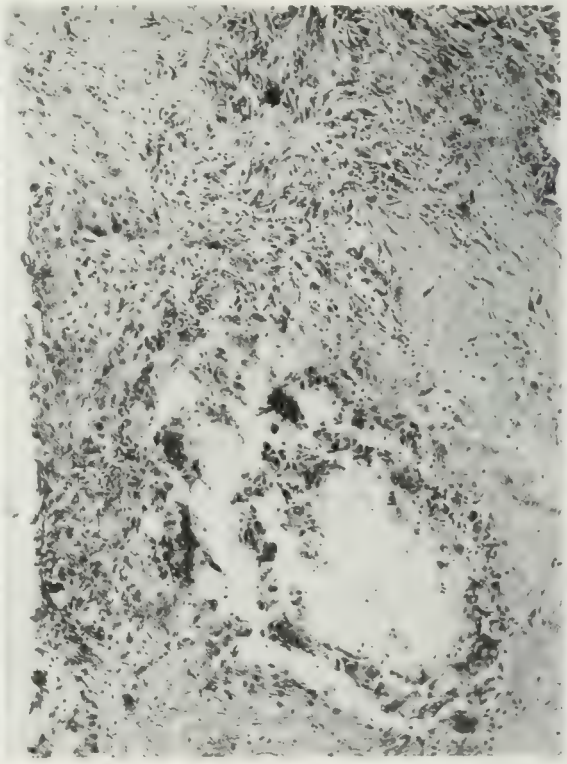


Fig. 15 (at left). Case 3. Microscopical appearance, showing much necrosis; also spaces of liquefied fat.
Fig. 16. Case 3. Microscopical appearance, showing necrosis, large spaces containing fat fluid, giant cells and new connective tissue.

Fig. 17 Case 4. Traumatic fat necrosis left breast. Note asymetry at lower inner quadrant of left breast.

Fig. 18. Case 4. Same as Figure 17, showing skin attachment.

Case 5, a woman weighing 180 pounds, suffered a definite trauma to the breast by falling 13 steps striking against a sharp corner of a post.

In three of our cases hypodermoclysis was a traumatic factor. This has led us always to suspect a lesion of fat necrosis where hypodermoclysis has been administered previously.

ECCHYMOSIS FOLLOWING TRAUMA

In two cases a definite ecchymosis followed the receipt of the trauma. Such a history may be a valuable guide in establishing a diagnosis of fat necrosis.

LACK OF PAIN

Four of the patients suffered not the slightest pain in or about the breast. One (Case 4) complained of a slight transient pain at irregular intervals, but the symptom was not a marked factor.

CONSISTENCY

A characteristic symptom of traumatic fat necrosis is the extreme hardness of the tumor. Every one of the five cases showed a consistence sufficiently hard to lead one toward the diagnosis of a malignant tumor.

NIPPLE RETRACTION

This symptom was obtained in but one instance and therefore may be regarded as an inconstant physical sign.

SKIN FIXATION

In all save one, definite fixation of the tumor mass to the overlying skin was readily elicited, and this should, therefore, be considered a fairly constant symptom of fat necrosis. This sign may strongly suggest a diagnosis of carcinoma.

DEEP ATTACHMENT

This was observed in two instances, but was lacking in the three other patients and cannot be regarded, therefore, as a constant symptom.

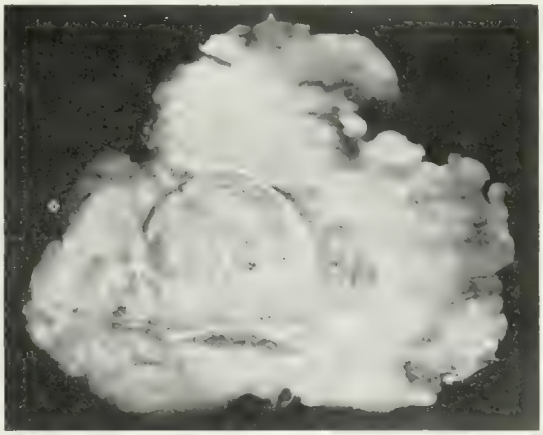


Fig. 19. Case 4. Traumatic fat necrosis. Gross lesion, showing fat lobules, areas of fibrosis, and necrosis.

Fig. 20. Case 4. Microscopical appearance. Large tissue spaces containing fluid fat, some necrosis, and new connective tissue.

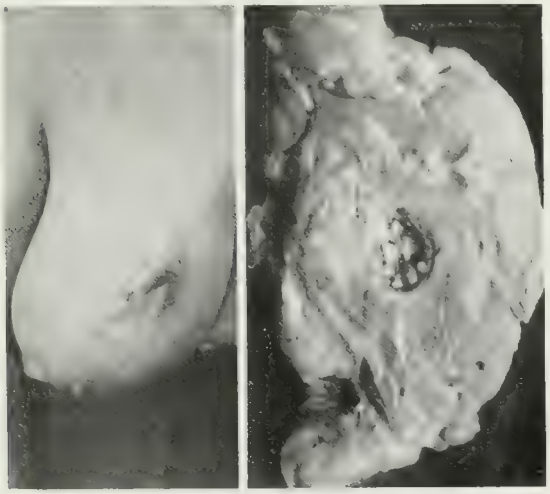


Fig. 21. Case 5. Traumatic fat necrosis right breast. Photograph taken a few days postoperative. Note heavy type of breast.

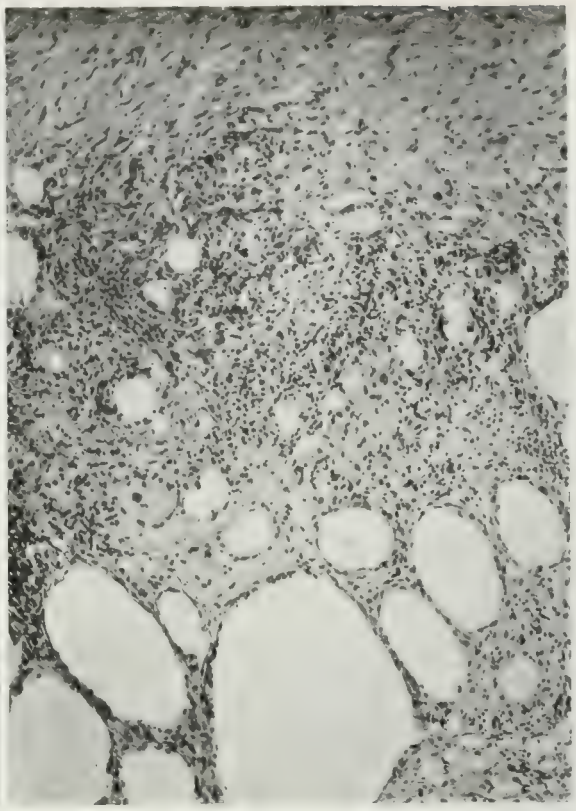


Fig. 23. Case 5. Microscopical appearance. Large tissue spaces with some areas of necrotic fat and new connective tissue.

NODES

In all of the patients, except one, no axillary or supraclavicular nodes were to be palpated, and in this single case the nodes encountered were exceedingly soft and gave no suspicion of malignancy. The absence, therefore, of any definite node involvement may furnish a differential point between fat necrosis and carcinoma.

DURATION

a. From the receipt of the trauma to the recognition of the tumor: There seems to be no constancy in this time factor, as in the series under report there was a variation from 3 weeks to 10 years.

Fig. 22. Case 5. Traumatic fat necrosis. Gross lesion, showing fat lobules, inflammatory zone, very firm wall, necrotic center containing liquefied fat, and small pieces of calcified tissue.

b. From the recognition of the tumor to the beginning of treatment: This period varied from 3 weeks to 10 months, so that here again no definite rule can be laid down.

In our former communication a rapid increase in the size of the tumor was noted. In the three additional cases now being reported no such history was obtainable and we, therefore, believe that rather less stress should be placed upon this symptom as a diagnostic aid.

CONCLUSION

The present study furnishes important additional evidence that traumatic fat necrosis of the female breast is a disease not infrequently encountered, and one which must always be carefully differentiated from carcinoma.

We beg to express the hope that this report may stimulate surgeons and pathologists to a more careful scrutiny of the gross and microscopical pathology of all tumors of the breast in the belief that a thorough search for evidence will reveal many cases of this disease hitherto unrecognized.

We desire also to suggest the possibility that some cases which in the past may have been diagnosed by the gross picture alone as carcinoma of the breast may not have been cancerous in their nature at all, but perhaps true examples of traumatic fat necrosis.

DEPARTMENT OF TECHNIQUE

SOME NOTES ON PLASTIC OPERATIONS[1]

BY LEO ELOESSER, M.D., SAN FRANCISCO
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THERE are two ways in which to replace a missing part of the body: one may use material from the neighborhood, if one can get it; or, if none is to be had, one may bring material from a distance.

In the first method the material is swung over to the defect on a stalk, and the stalk is retained as in Figures 1 and 2; the flap keeps its original blood supply, which runs through the pedicle. In the second method, when material cannot be had from nearby and must be got from a distance, it is necessary to uproot it, to lift it out bodily from its surroundings and transplant it to its new bed.

It is clear that the first method is the one of choice; not only is it more likely to be immediately successful, but it fills the gap with a tissue ultimately and always hardier. A flap that continues to be nourished through a pedicle is, of course, less risky than a free graft. There is always some risk that a free graft may die before the nutrient juices from its new bed have a chance to reach it. This immediate risk, however, is not the main objection to the free graft. The chances of life and death for the various kinds of grafts have been worked out pretty reliably, so that we know, for instance, that a Thiersch graft done under certain conditions will succeed, and that a Wolfe-Krause graft done under other conditions will not. This immediate risk is not the main objection—we can circumvent it, if a sudden uprooting seems too dangerous, by making a gradual transplantation, an Italian plastic (as in Fig. 5). The Italian plastic combines the first and second methods. It uses a pedicled flap at first, which it attaches to its new bed. It ends with a free graft. For, at the moment when the pedicle is severed, the transferred tissue *is* a free graft; it retains no connection with its old bed.

The main objections to the free graft lie not in its immediate results but in its ultimate outcome, and these objections hold whether we do our graft as a free graft at one sitting, or at several as an Italian plastic. The objections to the graft, the reasons why it is less likely than the flap ultimately to succeed are these: The graft always remains an island entirely surrounded by scar. The scar never disappears. Elastic fibers that grow through it are never normal; lymph vessels never pierce it. Blood vessels and nerves may in time pervade it, but it is a question whether they ever become entirely normal blood vessels and nerves. And so the graft island never comes entirely to resemble the tissue which it was intended to replace, nor even the neighboring tissue into which it was implanted. The scar barrier always remains. The tissue island always has a tendency to turn blue, especially when it is exposed to cold; it always has a tendency to become œdematous. It withstands but feebly infection and ordinary small injuries—pressure and bruises.

The flap, even if it has but a slender stalk through which its original blood vessels, nerves, and, above all, its original lymph vessels run, is preferable in the end to the island left by the free graft.

The only reason for resorting to free grafts at all is that they offer a source of practically unlimited supply, and that the material, being entirely separated from its old bed, may be twisted, shaped, and turned at will to fit its new one. A device then should be a good one that will enlarge the area from which a pedicled flap may be swung and that will make the pedicle freer, more easily turned, and twisted. This device is the semidetached flap.

THE SEMIDETACHED FLAP

The semidetached flap lies but a step from the flaps emphasized by Esser. Esser, a Hollander, who has published several articles in American journals[2], planned his beautiful facial flaps with the idea of having the main facial arteries run undisturbed through their stalks. Thus he laid his pedicles on the cheek so as to include the external maxillary vessels; in the nasolabial fold so as to include the angularis; or on the side of the

[2] Ann. Surg., 1917, lxv, 297

[1] From the Division of Surgery, Medical Department, Stanford University. Read before the Medical Society of the State of California, Coronado, May, 1921.

Fig. 1. The semidetached flap for nasal plastics. The flap outlined.

Fig. 2. The semidetached flap for nasal plastics. The flap turned down.

Fig. 3. The semidetached flap for nasal plastics. The skin of the pedicle cut through. The subcutaneous tissue, carrying the dorsalis nasi artery, remains intact. The flap retains a normal vascular connection.

Fig. 4. The semidetached flap for nasal plastics. Skin of pedicle stitched into place.

head so as to include the temporal. These large vessels flowing through even slender pedicles assured the nutritions of his flaps.

Esser, however, as far as I can find out, preserved not only the vessels in the stalks of his flaps, but left an attachment of skin. To leave the skin attached is, it seems to me, not always necessary. The skin in the pedicle hampers movement of the flap. It not only lessens the distance over which it may be pulled or stretched, but it lessens the arc through which it may be turned, or bent, or twisted.

Can we not entirely circumcise the skin if we leave intact a stalk of subcutaneous fat and connective tissue, with good blood vessels in it? This method will give the flap a greater range of motion; not only a greater range, but greater freedom. The blood vessels are more yielding than the skin, and may be turned through a greater angle without buckling or puckering. Even though the skin be cut all around, the flap is not detached so long as it carries an intact stalk of blood vessels running into it from underneath. It is not a free graft; it is not an island entirely surrounded by scar; it will not become blue and œdematous on slight provocation, for it keeps its original blood and lymph vessels that come from its original bed.

The semidetached flap is most useful in nasal plastics. The main objection to noses made from skin of the arm by the Italian method is that they tend to become blue and œdematous on exposure to cold. The same objection holds for noses made by a pedicled flap from the skin of the forehead, if the pedicle is cut in the later stages of the operation. Severing the pedicle turns the pedicled flap into a free graft. If, however, we bring the pedicle from the inner canthus of the eye, and preserve the frontal artery and the dorsalis nasi throughout all stages of the plastic, the new nose will always be nourished by a normal vessel. One may, in the final stages of the operation, sever the skin of the pedicle and transfer it to the glabella if one does not cut too deeply and leaves the artery uninjured in the flap. A nose made by this semidetached flap, which retains a stalk of normal blood vessels, will not become blue or œdematous. It will keep its vasomotor tone, and the blush will return to a spot made anæmic by pressure, as it does in normal skin.

THE STALK CARRIES MORE BLOOD THAN THE SCAR

The quantity of blood that a very slender stalk will carry is astonishing. The vessels in it meet the overload that is put upon them when they are called upon to carry the blood to a large flap with a surprisingly rapid dilatation. If one detaches the pedicle of an Italian flap at several sittings, and narrows the pedicle with incisions made a few days apart, the first incisions seem to lessen the blood supply of the flap very little. The flaps grow neither pale nor cyanotic. When, however, the stalk is very slender (a centimeter or so across) and is finally severed, it spurts most vigorously from large vessels. And if this last detaching stroke is made too early, say 2 weeks after the first operation, the flap may become necrotic even though the pedicle that nourishes it be no more than a centimeter across. The length of the line of union between the flap and the edges of the defect may measure many times the width of the pedicle, and yet it is the stopping of the blood supply through this last bit that turns the flap blue and necrotic. Even when the pedicle is severed at the proper time, when the circulation through the scar is sufficient, one will see, if one watches the flap, that it turns blue and cold the moment the pedicle is severed, and then gradually recovers in the course of half an hour or so. This observation shows that more blood runs through the natural vessels in the last centi-

Fig. 5 (at left). Italian plastic. The pedicle has been incised in several stages. It is ready for final severance. A rubber band is tied around it to test the viability of the flap before cutting it entirely through. The defect made by the flap, shown in black, has been covered by a Thiersch graft.

Fig. 7. A poor flap for an Italian plastic. The pedicle is too long. It is held in apposition by a mattress stitch over rubber tubing which will afterward cause the shaded area to slough. Insert shows a properly placed tension suture. A strong suture brings together the edge of the defect left by the flap and the edge of the defect which is to be covered.

meter of pedicle than through the newly formed vessels in the fresh scar, however long it may be.

TECHNIQUE OF THE ITALIAN PLASTIC

In order to lessen the danger of necrosis, one should sew the free edge of the flap accurately to the freshened edge of the defect. Hard and inflamed skin edges should be cut away, even though it be necessary to enlarge the defect. The suture should be made in sound skin; an infection in the suture line will greatly impair the vitality of the flap. The sutures should be of horsehair and should be just tight enough to bring the edges nicely together. Tight stitches make the tissue they include anæmic. Not only should the skin

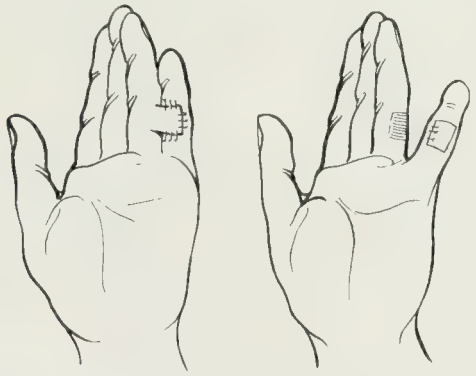

Fig. 8. A small Italian plastic for covering the defect after removal of a flexion contracture of a finger. The flap is taken from the side of one finger and led to the palmar surface of a neighboring one. Its bed is covered by a Thiersch graft done at the first stage of the operation.

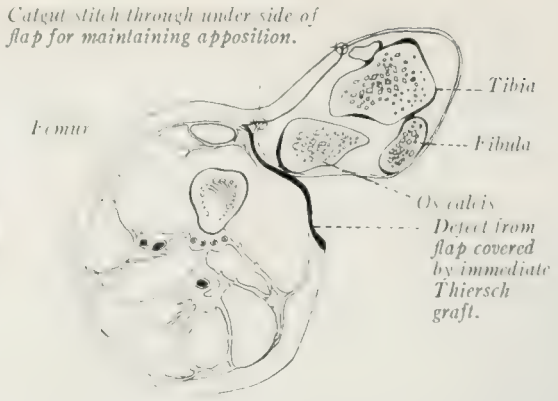

Fig. 6. Italian plastic from thigh to heel in cross section. First stage. The flap has a short bridge. It is held in apposition by a fine catgut stitch through its under surface. The wound in the thigh has been covered by a Thiersch graft.

edges be brought together accurately, but the raw under surface of the flap should be kept in broad and steady apposition to the base of the defect so that new blood vessels can grow into it from underneath.

If the flap will not stay in apposition by itself, it may be fastened to the defect by one or two fine No. 00 catgut stitches passed through the defect and the under surface of the flap (Fig. 6). It should never be pulled over on to the defect by a mattress stitch or by any other stitch that makes tension on the pedicle. A slight tension anæmia in the stalk will make a much greater area of anæmia in the body of the flap. The anæmic zone will spread out into the flap like a fan, the tip lying at the pedicle (Fig. 7). A mattress stitch through the pedicle will make a large slough around the stitch itself. Often the whole flap will slough. If tension sutures are unavoidable they should pass, not through the body of the flap nor through its base, but through the skin at each side of the base to the skin at the side of the defect. One may pull such stitches as tight as one likes without harming the nutrition of the flap. Indeed, if the flap is under tension, pulling it over toward its bed by sutures placed at each side will make it more slack and improve, not decrease, its circulation (Fig. 7a).

The free bridge leading from the base of the flap to the first point of attachment to its new bed should be just as short as is possible without putting the flap under tension. A long free bridge dangling between the base and the new bed is liable to infection and is wasteful of tissues. The bridge may be made short by sewing the sides of the flap well onto the defect, although these side

sutures are hard to place as they approach the base of the flap. The flap should be taken from a part of the body which will lie snugly and easily against the free edge of the defect, so that there need be no long free bridge.

In doing an Italian plastic it is a mistake not to give strict attention to asepsis. It is true that there will be some postoperative infection of the raw surfaces, that the patient will sweat and otherwise contaminate his wounds, and that the dressings will be more or less inaccessible and hard to keep clean. But the more carefully the patient is cleaned and shaved before the operation, the less infection will there be afterward.

The best way to limit an infection is to make the raw surfaces as small as possible. The edges of the wound left in the sound skin from which the flap was taken should be brought together by sutures. These stitches may be pulled very tight. If they are properly placed, they will decrease and not increase tension on the pedicle. If the skin cannot be brought together, and it is necessary to cover part of the wound with a Thiersch graft, the Thiersch graft should be applied immediately and not at a later stage. The immediate Thiersch graft not only saves time, for it heals the wound left by the flap by the time the pedicle is severed, but it decreases the raw surface open to infection. The immediate Thiersch graft takes well, even though they may have to bear the weight of the grafted extremity if it lies upon them. They are usually perfectly immobilized by the apparatus that holds the two grafted parts of the body together.

Infection damages the Italian plastic more than any other factor. A severe infection will kill the whole flap; but even a mild one, that the flap can overcome, will leave it boggy and thick, and make an ugly scar. A small stitch abscess will leave an obstinate and torpid ulcer once the pedicle is severed and the blood supply of the graft impoverished. The amount and severity of infection determine the time for cutting away the pedicle.

WHEN TO SEVER THE PEDICLE

When to sever the pedicle is the nicest question in the performance of the Italian plastic. One is between two fires. The longer the flap remains attached, the greater the scar, shrinkage, and infection; the sooner it is cut off, the greater the risk of necrosis. To balance properly the time between the two evils calls for delicate judgment.

The following plan has helped us to decide. We make an ample broad pedicle, and cut it through in several sittings. The first incisions

Fig. 9. The bridge flap. First stage. A bridge of skin, has been made between two parallel incisions, undermined, lifted from its bed, and stitched back into place.

into the pedicle are made early, about 10 days after beginning the plastic. They sever perhaps half or two-thirds of the pedicle, and are immediately stitched with a few horsehair sutures to the edges of the defect. Three or four days later a little more of the pedicle is cut. During the third week the blood supply of the flap is watched. One presses on it with the finger and sees how soon the blush returns to an anæmic spot. When it seems safe, usually after about 3 weeks, the test is made for final severance. A thin elastic band is tied around the pedicle. It need not be tied tightly. A very little pressure is enough to occlude the arteries. The flap is watched for 20 minutes or so. It turns blue and dusky when the band is tied—almost always. This blueness is probably due to a reflex cramp of the vessels. If the blueness disappears in 15 or 20 minutes, the flap is safe, and one may cut the pedicle immediately, or leave the band and cut the pedicle the next day (Fig. 5). If, however, the flap stays blue and dusky, one releases the band and waits a few days longer. By applying and releasing the band every few hours, one might perhaps stimulate the new circulation through the scar.

The patient should not be too uncomfortable in his retention apparatus. The bed of the graft and the place from which the graft is taken should lie together naturally. It is hard enough for the patient to lie immobile for 3 weeks, but to have his limbs forced into a strained position and kept there for this length of time is almost intolerable.

THE FLAPS

The flaps should not include too much subcutaneous fat. They tend to swell and to become boggy anyway. The skin of the flap should resemble, as nearly as possible, the skin of the neighborhood to which it is transferred. For a transfer to the hand or forearm, the other forearm is better than the belly or chest, and it is easier to hold the two forearms together than it is to fasten the hand to the chest or to the belly.

FINGER FLAPS

For flexion contractures of the fingers, the flap may be taken from the side of a neighboring finger. This gives a very pretty result and very little inconvenience—merely the tying together of two fingers. The scar on the volar side of the finger is excised. A flap is cut from the side of a neighboring finger, with its base toward the palm, and is stitched over the defect. The wound left by the flap is covered with a Thiersch graft. The base of the flap is cut in two or three stages, and the flap is finally severed after about 3 weeks (Fig. 8).

If a hand or foot is badly mangled and crushed so that some of the fingers or toes need amputation, a deal of patching and salvage may be done by turning the skin from the fingers that are to be cut off on to the back or the palm of the hand, or by leading it from one finger to another.

BRIDGE FLAPS

The principle of the gradual severing of flaps may be used in parts of the body with poor circulation, such as the leg, or where the flaps are to be made very long. A bridge flap is very much better nourished than a single pedicled flap. It may be made much more than twice as long as a flap with a single pedicle. It is first outlined by two parallel incisions and is undermined from one side to the other. The flap is left in place and the incisions are immediately closed with horsehair sutures (Fig. 9). After a week or ten days the incisions at the tip of the flap are united by a cross incision, which is again immediately closed. This outlines a pedicled flap which, however, is left in its original bed. After another week or ten days a fresh incision is made just to the inside of the original ones and the flap is swung into its final position. If the flap be planned as an Italian plastic, the pedicle is severed after 2 or 3 weeks and the plastic is complete.

TRANSPLANTATION OF STENSON'S DUCT FOR RELIEF OF DROOLING

A few words on an operation for the relief of drooling, which I have not seen described. The operation was performed upon the patient whose picture is shown to illustrate the bridge flap. A large recurrent cancer of the lower lip and jaw had been removed. It was necessary to remove the chin and more than two-thirds of the whole jaw. In order to finish the extensive operation quickly, the enormous gap was filled by sewing the tongue into it. A new lower lip and a buccolingual fold were reconstructed later. As the jaw had been removed up to the third molar on the right side, Stenson's duct debouched not more than 1 centimeter from the edge of the new lower lip. The mouth could not be closed tightly, so that the poor man was made wretched by his drooling. His shirt and waistcoat were continually wet with saliva. He re-entered the hospital and begged for relief. So much of the cheek and neck was gone that there was no material for perfecting the lower lip. An Italian plastic would have been too much for this old man to stand. The drooling came from the right stenonian duct. Both submaxillary salivary glands had been removed. It seemed to me, therefore, that if the opening of the parotid duct could be laid farther back toward the pharynx, the saliva might run down his throat instead of dribbling from his half-open mouth.

A transverse incision was made in the cheek and the duct, which was about 1½ inches long, was dissected from the front edge of the parotid to the papilla. The papilla was cut out from the oral mucosa, and a catgut stitch was passed through it. A small stab wound was made through the rear edge of the masseter into the back of the mouth near the pharynx, and the catgut stitch to which the parotid duct was fastened, was passed through it into the mouth. By pulling on the stitch the parotid duct was made to follow. A half inch or so of it was left dangling into the rear of the mouth near the pharynx. The man's drooling was greatly lessened, but not entirely stopped, by this operation. Some saliva still ran, I suppose, from the sublingual or other smaller salivary glands. The duct was transplanted in a second patient operated upon for cancer of the lip and cheek. This transplantation was done as a primary procedure, forming a step in the plastic

closure of the wound. The operation was easy, and might be worth considering in men whose lips cannot be closed, and the fronts of whose mouths have been destroyed.

SUMMARY

1. A graft of the whole thickness of skin, whether done at one sitting as a Wolfe-Krause graft, or at several, as an Italian plastic, always remains an island surrounded by scar.

2. It turns blue on exposure to cold and is little resistant to infection or trauma.

3. A pedicled flap which retains the normal vascular connections does not have these disadvantages.

4. A procedure is described for making a semi-detached flap, severing the skin of the pedicle but retaining its vessels. Such a flap has much of the freedom of a free graft but does not have its disadvantages.

5. More blood runs through the pedicle of an Italian plastic flap than through the line of union with its new bed, no matter how narrow the pedicle, or how long the line of union.

6. The vascularity of the pedicle should not be damaged by mattress or tension sutures.

7. Infection should be limited by covering the defect left by an Italian flap with an immediate Thiersch graft.

8. The viability of the flap is determined by temporarily occluding the pedicle with a rubber band before finally severing it.

9. The defect, after excision of a flexion contracture of a finger, may be covered by a flap from a neighboring finger.

10. Drooling may be relieved by transplanting Stenson's duct backward.

DEMONSTRATION OF BLADDER DIVERTICULA

By HERMAN L. KRETSCHMER, M.D., F.A.C.S., Chicago

As a rule, diverticula of the bladder are discovered during cystoscopic examinations. Cystoscopic examination gives information regarding the number and location of the diverticula but it fails to give us any information regarding their size or capacity. Failure to obtain this information is one of the limitations of cystoscopy in cases of this type.

Fig. 1. Roentgenogram of injected diverticula.

Cystography is used as an aid to cystoscopy in demonstrating the size and extent of the diverticula. Occasionally cystography fails to give the desired information because of the position of the diverticulum.

The passage of shadowgraph catheters into the diverticulum has been resorted to at various times and this may be followed by an injection of the diverticulum, through the ureteral catheter, with one of the usual opaque media which are used for this purpose. This method gives more accurate information than either of the two previously mentioned methods, and has been reported by various authors.

In order to define more clearly the extent of the diverticulum, we have combined the latter method with air cystography. After the diverticulum is injected, the bladder is filled with air. This procedure is an aid in producing a much sharper definition, a fact evident after an examination of the two plates.

Fig. 2. Roentgenogram of the injected diverticula after filling the bladder with air.

OPERATING CYSTOSCOPE IN APPLICATION OF RADIUM TO CANCER OF THE RECTUM FOLLOWING COLOSTOMY

By JOHN O. BOWER, M.D., F.A.C.S., Philadelphia
Associate in Surgery, Samaritan Hospital

IN malignancy involving the bladder or rectum, direct application or implantation of radium into the growth has been fairly successful. Undoubtedly, better results are obtained, however, when these growths are subjected to cross fire.

In the bladder this may be accomplished if the growth is situated on the anterior wall by applying radium directly against it, using an applicator or by the use of a hollow metal sound, crossfire being obtained by imbedding radium needles near or into the base of the growth through a suprapubic incision; if the growth involves the base, an efficient crossfire may be obtained by using a special applicator through the cystoscope in conjunction with a hard rubber applicator in the rectum.

A number of instruments have been devised for intravesical application, and crossfire, employing the methods mentioned, is not new. I wish, however, to report a method of treatment of cancer of the rectum using the operating cystoscope. Three cases of cancer of the rectum have come under my observation recently, in all of which an operating cystoscope and a specially devised applicator have been used to great advantage in implanting radium in the proximal portion of the growth, an effective crossfire being obtained by inserting radium, properly screened, against the growth through the anus.

Fig. 1. Radium needle applicator.

TECHNIQUE

a. A lower left rectus or inguinal colostomy is done under local or spinal anæsthesia, and the bowel is opened on the third or fourth day by the use of the thermocautery.

b. On the seventh or eighth day, the lower segment is flushed clear of all débris, using a 25 F. catheter attached to a 1000 cubic centimeter reservoir; when the fluid returns clear, the cystoscope with irrigating tube attached is inserted into the bowel, the obturator is withdrawn, the telescope is inserted and the special instrument holding the radium needle is introduced into the cystoscope, and the radium needle with silk cord attached is imbedded into the growth. The instrument is then withdrawn and as many needles as required introduced. The free ends of the

Fig. 2. Operating cystoscope and applicator with radium needle attached.

braided silk are caught with a hæmostat or fastened with adhesive tape to the patient's abdomen.

c. Then using a hard or soft rubber applicator, radium, properly screened, is inserted against the lower portion of the growth through the anus.

The advantage of this method of crossfire is maximum radiation due to accurate placing.

THE TREATMENT OF CONGENITAL HALLUX VARUS

BY ALEXANDER MACLENNAN, M.B., C.M., GLASGOW, SCOTLAND
Visiting Surgeon, Royal Hospital for Sick Children, Barclay Lecturer on the Surgical Diseases of Children, and Orthopaedics, Glasgow University

THE textbooks give very little information regarding hallux varus, and, indeed, most of them infer that the condition is merely part of the deformity in talipes varus. In the common variety of talipes equinovarus it is true that the varus element frequently persists as the well-known pigeon toe, but it arises from deformity of the tarsus, while in the malformation under discussion the defect is confined to the great toe. Were the deviation of the pigeon toe due to defect in the phalanx, its cure might rightly be left to be effected by the modern boot. The similarity of the two cases is so close that the malformation would appear to be stereotyped.

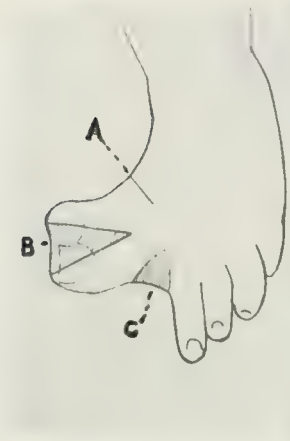

Fig. 1.

Fig. 2.

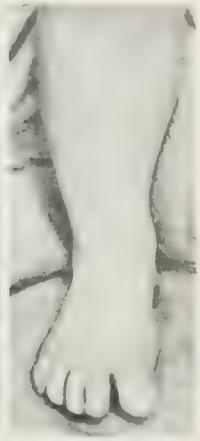

Fig. 3.

Fig. 1. Schematic drawing showing incision, graft, and wedge.
Fig. 2. Cast of Case 1, before operation.
Fig. 3. Case 1, Result of operation.

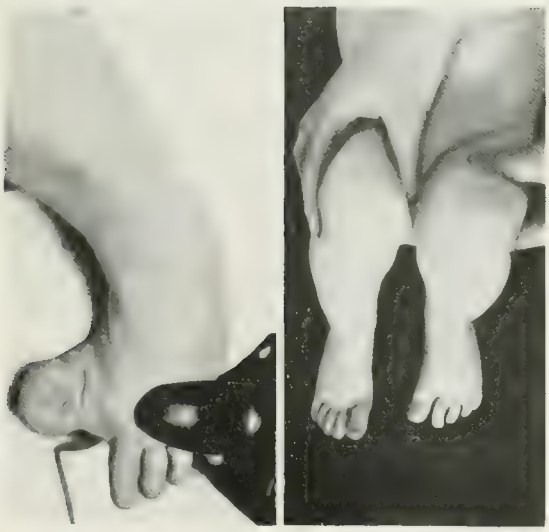

Fig. 4(at left). Case 2, before operation.
Fig. 5. Case 2, after operation.

The toes were double, fused, and were placed at right angles to the long axis of the foot. The malformation would appear to be stereotyped. The X-ray plate showed the metatarsal bone to be normal. Both cases were brought to the Hospital in 1920, within four months of each other.

The procedures adopted to correct the deformity may be summarized as follows:

1. The structures on the proximal side were divided by open incision at right angles to the axis of the toe (Fig. 1, incision).

2. The toe is then forced into alignment with the other toes, causing the formation of a wide raw surface on the inner side of the metatarsophalangeal joint.

3. A skin graft is required to fill in this gap and it is exactly formed by the redundant tissue requiring to be excised from the web between the great and second toes (Fig. 1, graft).

4. Retentive apparatus (plaster-of-Paris) is required after the operation but it is useless before.

5. The duplicity of the toe itself requires primary treatment. Removal of the innermost

toe would result in a cicatrix strong enough to excite a recurrence of the deformity. To prevent such an action, a scar should not be located along the inner border of the toe but a wedge should be removed from the tissue of the fused toes, each being taxed one half (Fig. 1, wedge).

This procedure is that commonly carried out for the building up of a single, in place of a bifurcated, digit.

The accompanying photographs show the condition before operation and the results obtained in Cases 1 and 2.

AMPUTATION STUMPS AND THEIR ADAPTATION TO ARTIFICIAL LIMBS

BY CARL BEARSE, M.D., BOSTON

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FOR about 1 year, while making orthopedic examinations for the Public Health Service, the writer had the opportunity of observing a large percentage of the amputation cases in New England that resulted from the late war. The comparison of these cases with the end-results of civilian amputations seen in general hospital and private practice forms the basis for this article.

Practically all ex-service men having amputations had been kept as patients in their respective service hospitals until they were able to walk with an artificial limb. They were instructed to wear these temporary artificial limbs for at least 6 months, to have them adjusted as necessary during this time, and at the end of this period to apply for permanent limbs.

After being discharged from army or navy hospitals, these patients were referred to the Public Health Service for further treatment or prosthesis as necessary. When first seen, these men called to have their temporary limbs repaired, to apply for permanent artificial limbs, or to have some stump affection cared for which prohibited the wearing of the temporary or permanent artificial limb.

The operative results were very satisfactory. Flexion deformities were extremely rare, and the range of motion in the joint just above the amputation site was usually unrestricted. A small percentage had tender scars from neuromata, and there were several that had discharging sinuses from osteomyelitic processes. Tender scars were resected and sinuses healed before such cases were referred for permanent artificial limbs.

It was rare to run across a man who had been operated on but once. Nearly all had had two or more amputations, the reason commonly being that infection was originally present; others had to be re-operated upon owing to an unsatisfactory amputation site having been selected, and for no other reason.

The outstanding feature about these cases was that they were treated through to the actual walking stage. How different was the story related by several limb makers who were interviewed. They stated that in civil practice most of their cases were referred by others similarly maimed; very few were referred directly by the surgeon; of those that were so referred very few were still under the surgeon's observation. But more than this, they stated that in many instances in selecting the amputation site the surgeon apparently gave no thought to the future usefulness of the stump. Owing to a lack of interest on the part of the surgeon in the interval between the operation and the fitting of the limb, many patients reported with deformities, such as flexion contraction, which could have been prevented and which seriously interfered with obtaining maximum service from the prosthetic appliance. In other words, lack of co-operation between the limb maker and surgeon frequently caused bad results which were preventable.

As a result of the observations made in the course of examining these patients, together with the information obtained from limb makers, with whom the writer has been in close touch, the following suggestions seem warranted.

THE STUMP

In general we want an amputation stump that will be covered with just enough skin and muscle so that the slack will be freely movable over the end, and yet not redundant. There should be an entire absence of sharp corners, pain, or tenderness, and the scar should be linear, non-adherent, and posterior to the end of the bone. The joint just above the amputation should have the full range of active motion, and above all, the stump

should be long enough so that the best appliance possible under the circumstances can be utilized.

In this country where artificial limbs have reached a very high state of development, owing to the large number of wounded as the result of the Civil War, a wooden socket is used. This is constructed of willow, covered with horse hide, and it is with this type of prosthesis in mind that the following recommendations are made.

UPPER EXTREMITY

The upper extremity from the prosthetic viewpoint provides a far greater problem than the lower, for there are no such standardized and satisfactory prostheses for the upper as there are for the lower extremity, so that no definite rules can be laid down for observance in amputating.

In the hand as much tissue should be left as possible, for all the limb maker can do is to produce something in the nature of a cosmetic result, except perhaps he may supply a hook to be worn, if the fingers are gone and manual labor is to be performed.

Amputation through the wrist does not usually make a good stump, for the styloid processes and articular ends of the bones are very apt to become tender and painful from the pressure and friction of the socket of an artificial hand. Amputation just above the styloids will give a shorter and far more satisfactory stump and yet will permit the wearing of just as useful an appliance.

In the forearm the general rule should be to save as much as possible up to a point 2.5 inches from the olecranon on the ulnar side. A stump shorter than this is of no use, as on flexion it ceases to exist as a stump anteriorly; the biceps tendon and the flexors of the forearm completely obliterate it, and push the socket of the artificial arm off.

An amputation through the elbow joint is unsatisfactory. It does not make a good bearing surface for the prosthetic appliance. It makes the artificial arm longer than the other, for the elbow joint of the artificial arm has to be at a lower level than the condyles of the humerus in order to get full flexion. Again, since through the condyles we have the greatest diameter of the arm, a wooden socket cannot be used, as all of it would have to be large enough to get by the condyles, and that would make it too large at the upper arm. Above the elbow we should save as long a stump as possible.

It may not be out of place here to mention the attitude toward arm appliances of our war veterans who have lost arms. All were given temporary arms on discharge from the army hospitals which they wore, for varying periods, to toughen the stump, for cosmetic purposes, raising morale, etc. When they appeared at Public Health Service offices for permanent arms, they practically unanimously requested mechanical arms, like the Cairnes, Dilworth and Miracle, with which the sleeve is filled out, which have a hand covered with a glove which looks quite natural, and which allows the flexion and extension of the fingers, and flexion and extension of the elbow. But after a thorough tryout many came back for a more simple apparatus, such as a hook, with which they could actually perform some manual labor, and which could be of assistance in their work. Of course for men who do not have to use their arms for heavy work, as office workers and professional men, the mechanical arm is the ideal one, as it can be used to hold light objects, and to manipulate a typewriter, for instance.

The important thing to remember in prescribing prosthesis for amputations in the upper extremity is that the remaining arm should be educated to its utmost, and the artificial arm should be used only as an aid. In most cases if an apparatus is furnished that has an interchangeable hook and hand, the latter for dress purposes, that is sufficient. It has been reported in recent literature that a large number of French wounded who had lost arms would not accept any artificial appliance whatsoever, but depended entirely upon their stumps.

THE LOWER EXTREMITY

In the upper extremity the stump serves as an anchor for an appliance, but in the lower, there enters in addition the very serious problem of weight bearing.

While the body weight is, to a certain extent, carried by all of the surface of the stump, yet certain parts of it are capable of carrying more than the other parts—and this apportionment of work for certain parts of the stump depends directly on the nature of the amputation. It is possible in certain cases to create a stump so that all of the body weight will be taken by its end—so-called "end bearing," and that is the ideal stump. However, a straight, end-bearing stump is only rarely obtainable and it usually requires substitution by utilizing the bony parts in the joint just above the amputation site. Such utilization of the bony parts together with the surrounding soft parts constitutes lateral bearing. A combination of end and lateral bearing may also be used.

The end-bearing type of stump requires no further description. While it offers a definite advantage, in that it gives a firmer hold on an artificial leg, yet in most cases no sacrifice should be made for it, as it is not essential. The amputation sites where end-bearing is imperative are in the Symes operation and through the knee.

In the lateral bearing stump the weight is borne, if in a thigh amputation, principally by the tuberosity of the ischium and the soft parts. In leg amputations, the weight bearing is taken by the lateral surface of the tuberosities of the tibia, and the upper part of the lateral surfaces of the tibia and fibula, but not the head of fibula.

THE FOOT AND ANKLE

Toes. A single toe should never be left, as it almost always becomes deformed, and offers difficulties when it comes to the wearing of a shoe. When all the toes are amputated, the best result is obtained by utilizing a plantar flap. The amputation completed, in most cases no further treatment is necessary, except an appliance such as a cork sole, to fill out the shoe. But some feet, owing to loss of the big toe and dropping of the anterior arch, may require arch supports.

The Chopart (mediotarsal) and Pirogoff (tibiocalcaneal) amputations are so whole-heartedly condemned by limb-makers, that they should, on general principles, be avoided. The objections are that at these sites, there is an unequal pull between the flexor and extensor tendons of the foot resulting in various deformities of the stump, usually equinus with tilting of the heel, and often complicated with pressure sores and tender areas. The prosthetic appliances required by these amputations are not only hard to fit, but they are clumsy and give rise to many practical difficulties. On the other hand there are many advantages in having the amputation site higher up, where excellent practical results can be obtained.

The tibiotarsal (Symes) amputation has caused more controversy than any other amputation. Surgeons on the whole are in favor of it, while artificial limb-makers generally condemn it. The disagreement is due to the fact that the operative result usually causes the artificial limb-maker a great deal of trouble.

Theoretically the Symes, if properly done, is an ideal operation, but in practice it often does not turn out as the surgeon wishes. Its success hinges mostly on one factor, that it be absolutely end-bearing, while what actually happens is that a tender scar, neuroma, displacement of the flap or other misfortune usually prevents the end of the stump from bearing weight.

If the stump turns out well and will bear weight, the ankle of the artificial leg has to be made thicker than the normal ankle, but as vanity plays as great a part in the maimed as in others, this forms a source of objection which the limb-maker cannot remedy, as making the ankle thinner will so lessen its strength as to make the limb dangerous to wear.

The surgeon will find it a good rule, unless he is particularly apt and skillful with the Symes, and the patient is willing to have the thick ankle, not to do this operation but to choose the higher site—the "point of election."

THE LOWER LEG

The ideal leg stump is one 6 to 8 inches in length; this is long enough to propel the artificial limb, can be fully flexed without the socket falling off, and the limb can be nicely tapered off, so that both ankles will look alike. There is nothing gained by having a longer stump, but instead there may be several disadvantages. For instance, in amputations lower down, the stumps are usually more poorly nourished, they have more of a tendency to ulcerate, are more affected by cold, and the scar is more liable to break open.

In cases where it is not possible to utilize as much as 6 inches of leg, an attempt should be made to come as close to it as possible, the minimum being the point where, on flexion to a right angle, the socket begins to slip off. The shortest effective stump seen was 1.75 inches below the lower border of the patella. This man can utilize his knee joint to its fullest extent in walking, and can sit with his knee flexed to a right angle.

In short leg stumps, it is advisable to remove the fibula, for the head of that bone in many cases is a source of persistent trouble. As the stump shrinks the head becomes more prominent; the socket rubbing constantly against the head causes the skin over it to become inflamed and tender, and the irritation may go so far as to set up a periosteitis.

THE KNEE

Above this point it is advisable to amputate at the knee joint, for even though very short stumps can be used as end-bearing in the flexed knee position, this is not advisable, owing to the frequent complication of bursitis, and the visible deformity at the knee in the apparatus.

Here again success depends on getting an end-bearing stump.

The ideal stump is the Stokes-Gritti, where the patella is left and placed in the depression between the condyles, but owing to the frequent mishaps in the operation, unless the surgeon is particularly

skilled in this technique he had better do a transcondylar amputation, near the upper part of the condyles, removing the patella. If the cicatrices are carried high and posteriorly this should give an excellent result.

THIGH AMPUTATIONS

The rule in thigh amputations should be the same as in the arms. Save all you can.

After comparing the limps in those that have had amputations through the thigh with those that have either a knee joint, or ability to carry weight at the knee, the first thought is "Could a lower amputation have been done?" While a thigh amputation with proper prosthesis gives a walkable limb, yet it is so inferior to amputations below or through the knee, that all measures should be attempted before sacrificing that joint.

If an amputation through the thigh must be done then, generally speaking, as much of the stump should be saved as possible. Speed states that however short the thigh stump, save it, rather than disarticulate. Even sawing through the neck of the femur gives a better and firmer base for the artificial limb than a disarticulation.

STUMP AFFECTIONS

The army has demonstrated the fact that an artificial limb cannot be worn too soon after an amputation; that the limb should be applied as soon as the stump can stand it, in many instances before the wound has entirely healed. If massage of the stump is started about 10 days after the operation, followed by bandaging with increased pressure, then hydrotherapy in the form of warm baths, hot packs, and contrast baths, and later with gentle pressure by the stump on a pillow with gradual increase in the amount of pressure, early weight bearing will be made possible. The reasons for having the patients walk early are that it raises morale, improves the general physical condition, and hastens shrinking and toughening of the stump.

Treatment of the various stump affections is the same as for similar lesions elsewhere, except that the wearing of the artificial limb should not be lost sight of. The longer the patient goes without his limb, the greater the tendency for the stump to become flabby, and consequently the longer the interval before he will be able to handle his artificial limb with any degree of facility and comfort. This is particularly true in the lower extremity and may be the cause of delaying their return to their occupations. In the after-treatment of stump affections, early walking is just as beneficial as after the original operation and for the same reasons.

Ulceration. This is the most frequent stump affection. The symptoms vary from being negligible to causing enough pain to prohibit the wearing of an artificial limb. The cause is either friction between stump and socket, mal-nutrition of short flaps with poor circulation, pressure of sharp corners on edges of bone, or local infection. In the treatment of this condition, an attempt should first be made to heal the ulcer without prohibiting the use of the artificial limb, but if treatment proves unsatisfactory, the stump should be put at rest. It may be necessary to excise the ulcer or even reamputate, in cases of painful, chronic ulcers associated with poor circulation, which prove recalcitrant to local treatment.

Enlargement of the stump. As a general rule, stumps atrophy after amputation, owing to loss of adipose tissue from the work they are put to in propelling the artificial limb, but not infrequently a stump will increase in size. This is usually due to the fact that the patient who has previously been engaged in some active occupation has now, owing to loss of a limb, taken up a sedentary vocation, and as a result has put on additional weight.

The remedy for this condition is to refer the patient back to the limb-maker for enlargement of the limb socket.

Stump swelling. This is a condition that comes on promptly in some stumps after the removal of the artificial limb, so that in some instances on awakening in the morning the patients are not able to get their stumps into the sockets. Several patients stated that they have had this overnight swelling for several years.

The treatment is to bandage the stump upon retiring. The Bender cotton elastic bandage is very efficient for this purpose.

Tender scars and neuromata. Until these complications cause enough pain to prevent the use of the artificial limb, the stump should not be molested, for should the subject be so unfortunate as to have frequent recurrences of these conditions it is easy to see where he may be laid up at frequent intervals.

It is sometimes possible to free adherent scars by physiotherapeutic measures, and so relieve the tenderness. Should this not help, resection of the scar must be done. The placing of the scar posteriorly to the stump at the time of the original and subsequent operations help in a large measure to prevent the tenderness.

The neuromata, if sufficiently painful to prevent walking, should be dissected out and severed

at as high a level as possible. Good results have been reported in preventing recurrences by the alcohol injections of these nerves after their severance.

If at the time of the original operation the nerves are divided at a higher level than the other structures, that will help to prevent the formation of painful neuromata. Then, should the nerves continue to grow, they are more likely to be lost in beds of muscle which serve as cushions and prevent pain on pressure.

Conical stump. This condition is most frequent in children, and is usually due to the growth of bone in the stump. The bone may become adherent to the scar, causing pain and ulcer formation. The treatment is reamputation. In adults a similar condition may be brought about by the flap being too short, causing retraction and shortening of muscles. The treatment is the same as for children.

Periosteitis (irritative). In some stumps due to irritation between the stump and the socket of the artificial limb, an inflammation of the periosteum may be set up. The diagnosis is made by ruling out other conditions and sometimes can be substantiated by X-ray.

The treatment is removal of the source of irritation, which means changing the socket, or going without the limb until the acute symptoms have subsided. In some stumps, if this condition is due to a thin flap, a reamputation may be necessary in order to get a thicker flap.

Exostoses. A proliferation of bone, usually from tabs of periosteum, giving rise to spicules in the end of a stump, may also be the cause of pain. The diagnosis is confirmed by X-ray. The treatment is the surgical removal of the proliferative processes.

Sinus. This is a fairly frequent complication. While in some instances it may be due to an osteomyelitic process, yet most of the cases seen had no bony etiological factor. The majority of these sinuses were in the middle of the scar. It is the writer's impression that they are caused by the too long-continued use of a wick for drainage purposes. Cotton thinks that often it may be due to sheer malnutrition from the mass of tough scar.

The treatment is surgical. If there is an osteomyelitic process present and the stump is long enough, reamputation is usually the more reliable and satisfactory method. If the sinus has no relation to bone and is at all chronic, complete removal of the sinus is the method of choice. The writer had occasion to see a woman 17 years after both legs had been amputated as the result of a railroad accident. One stump had healed perfectly, but the other had a persistent sinus which had been discharging pus since the amputation and which made walking uncomfortable. The sinus was resected; within 3 months the stump had healed, and now for 18 months has remained healed and symptomless.

If, at the time of the original operation, rubber dam is used for the wick and is inserted at the extremities of the incision and not kept in for more than 3 days, a non-osteomyelitic sinus should be a rarity.

Flexed leg stumps. This condition with rare exception is due to improper after-care. If, before the patient leaves the operating table, a posterior splint is applied and kept on until active motion is established and then early walking in an artificial limb prescribed, this complication will be avoided.

Since the first temporary limb can be used only for a relatively short time owing to the rapid changes which take place in a newly constructed stump it is advisable to construct a "home made" limb which will enable the patient to get up and around with all of its beneficial results. This limb can be made by making a cuff of plaster-of-Paris on the stump as far away from the end as possible (lateral bearing), and incorporating in it a double metal upright with a footpiece, or the army "pylon" can be used, which is a bifurcated wooden splint resembling a crutch. These are easily made, the patients can walk comfortably with them, and they also permit the dressing of the stump, should it be necessary.

Once the flexion deformity is established the treatment depends on several factors. If the patient can walk on a flexed stump and has no symptoms, and does not object to the evident deformity, then he should continue to do so. However, should the deformity be objected to or walking with flexed knee be painful, then either tenotomy, wedging or traction should be used, depending on the length of the stump, the length of time it has been flexed, and the condition of the joint. Once appreciating the value of the knee joint in locomotion, too many precautions cannot be taken to prevent this deformity.

SUMMARY

1. Do not lose sight of your patient after an amputation until a properly fitted limb has been prescribed and is worn. The sooner it is worn, the better.

2. Instruct patients that if at any later date they have pain, to return to you—and not to the limb-maker.

3. There are no standardized apparatus for stumps of the upper extremity. Generally speaking save as much as possible, avoiding joints.

4. On the lower extremity avoid the tarsal amputations—nothing is gained by using them, and there may be disagreeable complications.

5. The success of the Symes depends upon its being end-bearing; if doubtful about the outcome, amputate at the point of election.

6. The ideal site of amputation in the leg is 6 to 8 inches below the knee; try not to make the stump any shorter and there is nothing gained by having it longer—it may be detrimental.

7. In treating stump complications, it should always be borne in mind that the longer the patient goes without his artificial limb, the longer it will take him to become accustomed to wearing it again.

CORRESPONDENCE

TRUE AND FALSE KNOTS IN UMBILICAL CORD

To the Editor: Mrs. J. age 44, VI-para, reported her pregnancy early, as is the rule in our service here. Pregnancy was normal up to the thirty-eighth week, when the patient reported that there was absence of motion. Abdominal examination revealed motion, and also heart sounds could be elicited with the stethoscope. The patient thought there was undue "settling" but otherwise all was normal. Up to this time the movements of the fœtus had been more than usual, but they subsided now. However, the mother was satisfied that there was still movement.

Ten days later, I was called and after a normal labor, a male child was delivered, stillborn. The cord was around the neck twice, and had to be divided twice before the head could be delivered. No other interference was necessary; hence I call it a normal delivery.

There were four true knots and six false ones in the cord, which was normally long and of the usual size. The child had been dead possibly 2, or not more than 3, days, was perfectly formed, and normally developed. Save for the abnormality of the cord, the case was normal, and the mother made a normal recovery.

The case is of further interest, because the sister-in-law also lost a child the same way, but not in this service. This is the second stillborn child of this parent, but we have no history of the former case. I had never seen a case similar to this one, and therefore thought it worth reporting. The unusual activities of the fœtus no doubt caused the knots. The mother had lost a baby the second pregnancy before this one, and in this instance, had been particularly careful, as she desired another baby.

The Chinese say they never have such cases, and none has ever come under my notice. The specimen is in the Museum of the West China Union University.

WALLACE CRAWFORD, M.D.
Tzeliutsing, China.

A CORRECTION

On page 154 of the January, 1922, issue of SURGERY, GYNECOLOGY AND OBSTETRICS, in the report of the Hospital Conference of the American College of Surgeons in Philadelphia, the discussion on case records attributed to Dr. Edward A. Weiss of Pittsburgh should have been attributed to Dr. John D. Singley.

A. C. S.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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APRIL, 1922

THE SURGERY OF THE RIGHT BOWEL

THE early Egyptians understood the value of keeping the large bowel above reproach, for, as early as 1400 B.C., one may find directions for the preparation of enemata. It is possible they took their cue for this from the holy bird, the *ibis*, which was supposed to live forever. Of this bird Pliny in A.D. 77 wrote: "He washes the inside of his body by introducing water with his beak into the channel by which our health demands that the residue of our food should leave."

In the middle ages it was advised that places for defæcation be made warm and comfortable. In the seventeenth and eighteenth centuries scammony, with its griping and anal irritation, was the favorite drug; in the early nineteenth century, Abernethy with the everlasting "blue pill" mass and "black draught" came into vogue. Because of the misery these entailed, their use was abandoned and the intestines left to look after themselves.

Then came Metchnikoff, who tried so hard to make us believe that the entire large bowel is useless to the human race. Working along these lines, Lane with his brilliant surgery carried the profession almost off its balance. More sane judgment prevailed, and the poor old colon is not now sacrificed in the same ruthless manner.

There is a something in the right iliac region that passes for chronic appendicitis. This has been swallowed by the profession as an entity because there are recurring pain and tenderness often with nausea; there may or may not be constipation. A barium meal and X-ray examination shows retention in the appendix up to 100 hours. The tentative diagnosis is confirmed, the appendix is removed but the patient is not cured! Why? Because, while there is a fibrosed appendix from repeated irritation, this is not the whole trouble. In about 3 to 6 months, the patient returns with the same symptoms, only a bit more exaggerated, and a further examination together with the X-ray confirms the fact, already suspected, of adhesions. Another operation is advised and carried out, and the surgeon is surprised to find so many adhesions, which he tears and pulls apart. He did not look for them the first time, else the surprise would not be so great! Again the patient is well for a few months when those adhesions again form. What is the answer? Had the condition been gone into carefully in the first place one would have found that in addition to the pain, tenderness, and nausea, the patient was easily upset nervously, was in a general state of ill health, with so-called "indigestion," lassitude, drowsiness in the afternoon, loss of appetite, and that while there might be nausea at any time, it was worse in the early morning and was

not necessarily associated with the pain. A careful physical examination will, by careful palpation reveal a large, flabby cæcum that, just as one thinks he is about to grasp it, slips from under the examining hand. An X-ray examination, preferably enema, will show an absence of haustra in the cæcum and ascending colon, with retention in a cæcal pocket for days, although the bowels may evacuate daily. To clinch the diagnosis, an opaque enema is given and with the X-ray one sees the cæcum balloon and remain ballooned, and then the barium begins to flow through the ileocæcal valve. In one very pronounced case this enema was followed up the small bowel until a perfect duodenal cap was produced. As a rule, however, one must desist by the time the duodenojejunal junction is reached because of the discomfort produced.

How is the condition to be remedied? The removal of the appendix does no good. The reconstruction of the ileocæcal valve is of even less value! One may bear in mind that the cæcum in these cases approaches the herbiverous type of bowel, and that, therefore, some cases are benefited by eliminating meat from the diet. In order to change the bowel flora, a piece of a yeast cake may be eaten night and morning. Flaxseed added as an article of diet assists in securing daily bowel evacuations. Abdominal massage is of great benefit and when in the upright posture the wearing of an abdominal lift corset.

Failing to get physical efficiency in this way, in the early mild cases where the cæcum is still an abdominal organ, the removal of the appendix, combined with a plication of the cæcum, after dividing with sharp dissection a constricting band at the junction of the cæcum and ascending colon over the outer leaf of the mesentery, is probably all that is required. When the cæcum is a pelvic organ and is in a similar early stage of atony, the removal of the appendix, with cæcal plication and then a burying of the plicated margin into a slit in the posterior parietal peritoneum, serves a useful purpose.

In the advanced cases, where the appendix has been removed, and a series of adhesion-breaking, health-breaking, and heart-breaking operations have already been done, nothing short of a radical resection of the terminal ileum and cæcum, with an end-to-end anastamosis of the cut ileum to the ascending colon or to the hepatic flexure as the case may require, will be of any benefit.

There has been no mortality in the cæcal plication cases, nor has there been in the plication and implanting cases, and so far the results have been satisfactory.

In the resection cases, in 1920, we had twenty in which there were four deaths. Of these deaths two had developed fæcal fistulæ, and two others had developed colon infection in the wound. In the early months of 1921 we had 18 resections with one death. no fæcal fistula and two colon infections in the wound. We attribute the improvement in results to the use of a piece of rubber tubing at the site of the anastomosis. This is passed per rectum in from 5 to 17 days.

F. N. G. Starr

MYOMECTOMY

ABOUT 12 per cent of white and 30 per cent of colored women of 50 years of age have uterine myomata. Fifty per cent of colored women of 35 years who have not borne children have such tumors. Only a small proportion of women with uterine myomata have symptoms, and only myomata which cause symptoms require treatment, but all women who have myomata should be examined at intervals to see that the tumors are causing no harm.

The most common conditions indicating operation are those which result from: (1) hæmorrhage; (2) degeneration of the tumor (22 per cent); (3) malignant disease, usually carcinoma of the body of the uterus (4 per cent); 10 per cent of women more than 50 years of age who come to operation for uterine myoma have complicating malignancy; and (4) tumors causing pressure. The great majority of patients who have tumors extending above the pubes belong to this group. It has been shown that in 30 per cent of patients with myomata of the uterus which cause symptoms, the ovaries and tubes are seriously diseased, and often require operation independent of the myomata.

In about 5 per cent of our cases the diagnosis of uterine myoma was more or less clouded. A tumor of the ovary, either benign or malignant, was usually the cause of the failure of differentiation, especially when myomatous nodules, of no great consequence in themselves, were coincident in the uterus.

The use of the roentgen-ray and radium in the treatment of disease is in many respects most encouraging. In the treatment of myomata, radium has the advantage, containing, as it does, definite and measurable quantities of γ-rays which can be applied precisely.

One cannot escape the conviction that in cases of myoma the use of radioactive substances is a most destructive method of treatment, non-operative, it is true, but certainly not conservative. In the majority, if not all, of the cases in which rather large myomata disappear under their use, the patient loses the function of the ovaries, tubes, and uterus, although the non-functioning remnants are left in place to await an uncertain future. Many patients with small symptomless myomata are treated with radium on doubtful indications. Radium has a great field of usefulness in the treatment of myomata. For small tumors causing hæmorrhage in the menopause period, radium is the treatment of choice, and also for symptom-producing tumors in obesity and certain constitutional maladies, but its use has definite limitations.

Hysterectomy has been and still is the operation of choice for the greater number of symptom-producing myomata, and it has much to commend it. In patients more than 40 years of age, especially in whom the exact pathological condition is not established in every particular, exploration followed, if necessary, by hysterectomy is the prudent procedure. Supravaginal hysterectomy has a definite technique which has been so thoroughly and carefully worked out in the past 20 years that it has become the standard operation. Preserving the cervix renders the operation easier and safer, but the cervical remnant has no function and some unfortunate propensities. First, it leaves the patient with an average liability to cancer, and, second, it is usually the cause of those troublesome vaginal discharges called leucorrhœa, due to subsequent disease of the mucous glands of the cervix, and third, it may lead to greater vaginal shrinkage and tenderness. For these reasons, total hysterectomy, provided it can be performed without undue risk, is the better operation.

We have been able to save at least one ovary in about one-half of all the hysterectomies for myomatous disease. From the standpoint of conservation of the ovary, hysterectomy may be preferable to treatment by radium and the roentgen-ray, since if myomata are effectively irradiated the ovaries are destroyed. Acknowledging, as we must, the great benefits which have accrued to women through hysterectomy, we cannot blind ourselves to the physical and nervous changes which sometimes follow,

especially in young women. It would be interesting to know the percentage of divorces that have had their origin in this operation.

To one who takes a view of the whole situation, myomectomy must commend itself as a truly conservative procedure, and often the operation of choice. It has been urged against myomectomy that it is dangerous. From January 1, 1891, to November 1, 1921, 909 myomectomies were performed in St. Mary's hospital, with 7 deaths, a mortality of 0.7 per cent. Again it is said that other myomata may develop. In our experience only 2 per cent of patients came to hysterectomy later, and 60 per cent of these did not have recurrent myomata. We do not often perform myomectomy for patients more than forty. If conditions are such as to make the operation relatively safe, it is performed for patients from 35 to 40 years. It is performed for the majority of patients under 35 years, and for practically all under 30 years. Since symptom-producing myomata are much more frequent after the fortieth year, it may readily be seen that we have been conservative in choosing cases.

Myomectomy is more difficult to perform than hysterectomy, because the technique must be varied according to the character, situation, size, and number of tumors, but it does not present greater difficulties than can be easily mastered by the experienced surgeon. Twenty-three patients were pregnant at the time of operation; 7 of the pregnancies were ruptured extra-uterine, and 16 were intra-uterine. None of the patients died. The majority of patients with intra-uterine pregnancies following myomectomy went to term and were delivered of living children. When it is considered that in the latter group the tumors were degenerating and causing acute symptoms, and that in a large proportion indications of spontaneous emptying of the uterus were present at the time of the operation, it is remarkable that the disturbance subsided so often without premature expulsion of the child. In no instance in our experience with myomata complicating pregnancy have we been obliged to perform hysterectomy on the pregnant myomatous uterus with a non-viable child.

Five hundred four of our series of myomectomized patients are traced. Twenty-four had had one child since the operation, and seven had had two or more. Forty-three living children following myomectomy on 504 patients, only two-thirds of whom were married, is a strong argument for the conservative operation.

From this investigation of the actual results covering a period of 25 years it is evident that the operation of myomectomy has not received the attention it merits. We should make every effort to improve the technique and further the indications for the operation. It is the only truly conservative procedure for myoma of the uterus; an operation which removes the tumor and leaves the patient as she would have been had she never possessed it.

William J. Mayo.

CONSERVATION OF THE GALL BLADDER

FOR some years there has been a growing tendency to remove the gall bladder in all cases where operation upon it is indicated and the condition of the patient as a surgical risk does not contra-indicate it. The reasons for this are plausible but not convincing. Has not the enthusiasm of the surgeon in favor of radical treatment got the better of his surgical judgment and caused him to overlook the just demands of the gall bladder for conservative treatment?

One surgeon of great experience writing in 1913 said: "Cholecystostomy is the operation of choice because it saves this valuable organ for future function," but in 1921 he reverses his position when he writes: "Cholecystectomy has taken the place to a large extent of cholecystostomy because of the well-known fact that the gall bladder following cholecystostomy is a liability rather than an asset to the patient." So, Mayo-Robson protested against the indiscriminate removal of the gall bladder, asserting that cholecystostomy is "unquestionably the operation to be aimed at in the greater number of cases of cholelithiasis," and Moynihan said: "The majority of surgeons will agree with Maurice Richardson that 'the end-results in cholecystostomy are certainly as gratifying as end-results have ever been in any class of abdominal operations.'"

Is it not worth while considering that the profession may have gone too far and would it not be more reasonable to adopt that attitude, as in other departments of surgery, where surgical judgment counsels that each case be decided on its merits with the desire to do nothing in excess?

The reasons for radical practice are obvious. It is claimed that simple drainage is not curative, relapses occurring far more frequently than after removal; that after cholecystectomy the ducts dilate, thus compensating for the loss of the gall bladder, and the system adapts itself to the changed conditions; that in nearly all cases of cholecystitis there is associated hepatitis and, quite frequently, pancreatitis, due to invasion through the lymphatics (Deaver, Graham, Judd), and that the best way to cure these conditions is to remove the gall bladder, the seat of infection; that once infected, the gall bladder cannot be cured by drainage, owing to the imbedded infection in the deeper layers of the organ, and that it should, in all cases of disease, be treated like the appendix and be removed. In other words that the gall bladder is a useless organ and should be removed whenever the surgical risk justifies it.

"The fact that few ills follow upon removal of the normal gall bladder means merely that the body has adapted itself to the loss, not that the loss is unimportant. In this connection the surgeon would do well to remember that uncertainty as to function and confidence in readjustment are at best questionable motives for adventures in ablation." (McMaster and Rous.)

The gall bladder should *not* be placed in the category of the appendix; it is not a vestigial organ, but has a distinct function which should be maintained where possible. It not only acts as a backwater to relieve the tension of the steady down-pouring of bile, but as an intermittent reservoir for a fluid which is needed in the duodenum to assist in pancreatic digestion by neutralizing the acid chyme, and which is supplied at just the right time, by virtue of that beautiful mechanism, which inhibits the sphincter of Oddi at the same time that the gall bladder is stimulated to contract.

This storage function is made more evident by the recent work of McMaster and Rous, showing that the capacity of the organ is greatly increased by its inspissating power on the bile. "The restriction of the concentrating activity to the gall bladder is good evidence that the latter has special significance for the organism." (McMaster and Rous.) Furthermore, admitting that in every case of cholecystitis there is associated infection of the liver, has it been conclusively shown that drainage may not relieve, not only the gall bladder, but the liver as well? Does not this predilection for removal of the gall bladder tend to warp surgical judgment and lead

to the useless sacrifice of gall bladders that might be saved? Murat Willis, calling attention to the report of 397 cases in the Peter Bent Brigham Hospital, in which only 50 were non-calculous, deplores the fact that, of these 50, 16 were normal gall bladders; so that 1 patient out of 3, subjected to cholecystectomy for "simple cholecystitis parted with a normal gall bladder," the failure of the patients to obtain relief, "confirming the belief that the diagnosis of cholecystitis was a faulty one."

Instead of saying, then, that the gall bladder should be removed except when contraindicated by the operative risk, would it not be better to reverse the formula and say, the gall bladder should only be removed on account of definite crippling pathology which will preclude restoration to useful function? The removal of the gall bladder changes physiological relations, which should never be done without adequate reason. From the time of Sir William Ferguson conservative surgery has had a recognized place and our striving should be to prevent unnecessary mutilation. Other organs have been removed without apparent detriment, but such removal without justification is crippling and should be discountenanced.

F. W. Parham.

TRANSACTIONS OF SOCIETIES

CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD DECEMBER 2, 1921, DR. DEAN LEWIS, PRESIDING

THE DIAGNOSIS AND TREATMENT OF SOME COMMON INJURIES OF THE SHOULDER JOINT

DR. ROBERT W. LOVETT, Boston, Massachusetts, read a paper, by invitation, on the diagnosis and treatment of some common injuries of the shoulder joint. (See p. 437.)

DISCUSSION

DR. JOHN RIDLON: I am glad to take this opportunity to admit that the difficulties encountered in treating injuries to the shoulder joint have always been more troublesome and more obscure to me than those in treating all the other joints put together. It has been a great satisfaction to me to hear a reasonable exposition of the conditions such as we have heard from Dr. Lovett.

DR. EDWIN W. RYERSON: Two points struck me very forcibly in this paper: first, the question of neuritis. I am beginning to believe that there is no such thing as a neuritis of the shoulder, a neuritis of the sciatic nerve, or a neuritis of the lumbar region, so-called lumbago, except in those cases where metallic poisoning or alcohol has had something to do with it. I believe they are dependent upon some other condition. About 6 years ago, when Codman's work was penetrating through my intellect, I saw a woman who had a most intense and terrific pain in the right shoulder. Treatment with heat and all other means that could be used for it gave no relief. Distinguished neurological consultants saw her and advised the actual cautery, which was applied, but it gave no relief and even made the pain worse. An X-ray picture showed a deposit in the region of the subdeltoid bursa, and after a few days more of great suffering she consented to have this opened, which I did through the deltoid muscle. The bursa was about the size of a silver half dollar and was completely filled with fine calcareous material which, when rubbed between the fingers, gave the impression of little sharp crystals. We are now told by some writers on this subject that this was probably not in the subdeltoid bursa but in the supraspinatus tendon sheath. I do not believe that. I believe it was a definite affair in the subdeltoid bursa. Cases of this kind need operation. It is perfectly true that under conservative treatment, especially with an abduction splint, the deposit in the subdeltoid bursa may disappear with considerable rapidity, but in this case, operation was undoubtedly indicated.

A second point which I think ought to be mentioned is the fact that a subacute arthritis is very apt to occur in the shoulder joint. It may be rheumatoid or osteoarthritic in its nature, and is more common than Dr. Lovett has indicated in his paper. This, of course, has to be treated along general medical and surgical lines.

The lesions of the supraspinatus tendon are interesting. I saw a gentleman a few weeks ago who in making a backhand stroke in playing tennis felt something crack in his shoulder, and an X-ray picture showed that a piece of bone at the insertion of the supraspinatus tendon was pulled loose. He got well in 2 or 3 weeks with an abduction splint.

Dr. Lovett emphasizes the importance of putting up these cases in abduction. No one should forget to do this in the somewhat obscure cases of shoulder-joint lesions we see. It is comfortable except from a cosmetic standpoint, but there are some of these cases that should have the arm put up in that way, instead of simply at the horizontal plane, although that is much more comfortable.

DR. D. B. PHEMISTER read a paper entitled "Hematogenous Staphylococcus Infections in Various Organs Secondary to Skin Foci."

GROSS PROBLEMS FOLLOWING OSTEOMYELITIS OF ADOLESCENT LONG BONES

DR. KELLOGG SPEED read a paper entitled "Gross Problems Following Osteomyelitis of Adolescent Long Bones." (See p. 469.)

DISCUSSION

DR. JOHN RIDLON: I think a word might be said about simple fractures involving the epiphysis and the nutrient artery region, lest it be assumed that simple fractures may result as do infected fractures.

I have broken many bow legs, entirely disregarding the nutrient artery of the tibia, choosing the most favorable place to break the bone, and have never seen arrested growth from such a break. I have broken the lower end of the femur as low down as possible many times for knock-knees, ignoring the epiphyseal line, and I have also deliberately in a few cases taken off the lower epiphysis of the femur for the correction of knock-knees, and

in none of these has there been any arrest of growth. The law regarding simple fractures obviously is not the same as the law that must be regarded in the infected fractures.

Dr. E. Wyllys Andrews: In the pathogenesis of arrested growth from epiphyseal injuries, as Dr. Ridlon and the reader of the paper both stated, infection plays a very imporant part, but not absolutely a necessary part.

The occurrence of arrested growth after a simple fracture of the epiphysis is very rare, but I have seen it in two cases. Both of these cases were called to my attention sometime afterward on account of the occurrence of extraordinary deformity, which was the cause of a lawsuit for damages. It is appalling to think that so simple a thing as a simple fracture of the lower end of the ulna, or radius, or tibia, or any of the bones where there are tears, can be violently injured, relieved by proper reduction, with apparent recovery, and then years afterward result in a tremendous unsightly deformity. That is what happened in the case of one of my colleagues, and the part that was appalling was that we could not find anything for a long time in the literature to justify the grounds of defense we were trying to work out for the purpose of exonerating the practitioner from all blame. Both of the cases I have seen happened in the forearm. Both of them had the forearm set, and the arm remained for some years apparently perfectly well until the development of an extremely bad deformity. In both cases damage suits resulted.

In trying to arrange for a defense in the cases involved we accumulated a tremendous lot of reprints and made an extensive research of the literature, but we found the question very inadequately discussed. The paper we have had tonight is perhaps almost pioneer in this field.

Dr. Harry E. Mock: The pictures shown by Dr. Speed of the active growth in the upper epiphysis of the fibula is well illustrated in amputation cases. In amputating the lower leg in children this fact should be borne in mind. In the last two years in at least ten or twelve cases of old amputations in children from the Spaulding School, I have seen a projection of the fibula beyond the stump, requiring secondary amputation. This bone has a more active growth than the tibia itself, and, in amputating, that fact should be considered. The bone should be removed completely in high amputations or removed from 2 to 3 inches higher than the tibia level.

Dr. Dennis R. Crile: While the growth in length in the tibia, fibula, and radius occurs both in the distal and proximal ends, such growth in the ulna occurs at the distal end. The anatomical arrangement is such that the sigmoid cavity butts against the lower end of the humerus at a point distal to the epiphysis, so that growth from the proximal epiphysis does not lengthen the bone. This explains in some measure why we get such extreme overgrowth at the lower end of the ulna. The rate of growth of each epiphysis of the radius is only half the rate at which the ulna normally grows from its distal end alone. For this reason I believe that destruction of the distal ulnar epiphysis will result in permanent shortening of the ulna, while damage of the proximal epiphysis of the ulna will make very slight difference in the length of the ulna. That I think is an anatomical fact worth remembering. Excision of a section of ulna above the epiphysis corrects the condition without introducing the element of later deformity.

Dr. Speed (closing): There is much discussion in comparative anatomy on the point mentioned, especially in relation to the blood supply, and I know of course the fibula is an exception to the epiphyseal law, and I so stated in my paper. I tried to narrow the subject down to acute inflammatory conditions. I have seen two cases of epiphyseal separation with stoppage of growth after a fracture. There are certain more remote biological points I did not go into but viewed the matter from a purely clinical standpoint.

AMERICAN COLLEGE OF SURGEONS

FEBRUARY MEETINGS OF STATE SECTIONS OF THE CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

GROUP meetings of the American College of Surgeons were held during February in five group centers: Lincoln, Nebraska; Kansas City, Missouri; Los Angeles, California; Houston, Texas; and Memphis, Tennessee.

The meetings carried the usual two-day program: clinics in the forenoons of two consecutive days, hospital conference the afternoon of the first day, public gathering the same evening, and the scientific session the afternoon of the second day.

The speakers from the central office were Dr. Franklin H. Martin, director general of the College; Dr. George W. Crile, a regent of the College; Mr. T. E. Allen; and Mr. R. I. Raymond. The Rev. C. B. Moulinier, S. J., president of the Catholic Hospital Association, attended and addressed all meetings.

Meetings in Lincoln for the states of Iowa, Nebraska, and South Dakota, were held February 6 and 7, under the chairmanship of Dr. A. R. Mitchell of Lincoln, at the Lincoln Hotel and at the City Temple Auditorium. There were 76 Fellows in attendance and the local clinics were well filled. About 250 attended the hospital conference, 1,000 were present at the public meeting, and approximately 200 met at the scientific session.

The meetings for the Missouri and Kansas sections were held February 9 in Kansas City at the Baltimore Hotel and the Grand Avenue Temple. Dr. Daniel Morton, counselor, presided in the absence of Dr. John F. Binnie, chairman.

The clinics carried heavy programs and were well attended. About 125 Fellows were present at Kansas City, and their number was heavily reinforced by the attendance of the local medical fraternity. There were about 400 present at the hospital conference, a good gathering at the public meeting, and about 250 at the scientific session.

The group meeting for Arizona, California, and Nevada was held February 17 and 18 in Los Angeles, under the chairmanship of Dr. Stanley Stillman. The work of the local committee was facilitated by the convenient arrangement of having all meetings in the Alexandria Hotel, where sufficient accommodations could be afforded.

One hundred and twenty-two Fellows were in attendance. The College had the pleasure of entertaining Judge Harold M. Stephens of Salt Lake City, who spoke at both the hospital conference and the public meeting.

The hospital conference drew nearly 350, the public meeting about 900, and many were turned away. The scientific session was attended by more than 400, many of the local surgeons and doctors being present.

The Houston meeting, February 23 and 24, included the sections for New Mexico, Oklahoma, and Texas. Dr. Bacon Saunders presided.

Ninety-four Fellows were in attendance, and at this group meeting the College had the co-operation of the Harris County Medical Society. This co-operation, as was evidenced at the St. Paul meeting in January, proved a helpful arrangement and one desirable to have hereafter wherever possible.

The clinical meetings in the forenoon of both days had an unusually good attendance, doubtless due to the participation of the members of the Harris County Society.

The hospital conference was fortunate in being addressed by Mr. Robert Jolly, superintendent of the Baptist Hospital, of Houston, whose inspirational talk to the hospital people was of notable value. About 200 attended.

The public meeting was held at the First Presbyterian Church, and the speakers had the pleasure of addressing a thoroughly packed house of about 1200.

The scientific session was attended by more than 200, including a large number of the Harris County Medical Society.

The Tennessee, Kentucky, and Arkansas sections met in Memphis, Tennessee, February 27 and 28, under the chairmanship of Dr. W. A. Bryan. The activity of the local committee here was particularly evident in drawing out an excellent attendance to the meetings under un-

favorable weather conditions. One hundred and seventeen Fellows were registered in Memphis.

The hospital conference at the Chisca Hotel, in addition to the regular speakers, listened to an address by Dr. W. R. Bethea, in which he covered the necessities of hospital administration and very excellently interpolated the use and value of the hospital standardization program.

The public meeting was held at the Goodwyn Institute, where an audience of about 800 gathered. The scientific meeting was held at the Gayoso Hotel with 250 present.

The above necessarily brief résumé is altogether inadequate to present the effective activities of the local and sectional committees and the cordial interest of the local physicians and surgeons. Least of all does it convey the widespread interest on the part of the general public in the work of the College in the standardization of hospitals and scientific medicine.

It is increasingly evident that the state executive committees are effectively intent in thorough organization within their own states and are helpfully co-operative one with another in the group meetings under the auspices of the committee for the host state. When the difficulties of travel, hotel reservations, location of headquarters and meeting places for committees and open meetings are all taken into consideration, it is remarkable with what smoothness the machinery of these large meetings, covering such wide range of territory, has operated.

No less commendation is due the local committees in the cities entertaining the sections. It has been the usual experience that every facility to lighten the necessary burdens of these gatherings has been provided long before the arrival of the Fellows of the College and the representatives from the central office.

A significant and helpful feature throughout has been the presence and interest of the local physicians and surgeons who are not members of the College. It is evident that the meetings have in some definite measure fulfilled their obligation of carrying the message of the College to them.

It is the purpose of the group meetings to present hospital standardization to all the hospital people who may be brought to them; and certainly a large measure of commendation is to be accorded the trustees, superintendents, staff members, internes, and nurses who have availed themselves so interestedly of the message of these meetings.

An element of increasing importance in the sectional gatherings is the presentation to the public of the definitely three-fold program: hospital standardization, the aims of the college toward the furtherance of best surgical service to the public and the safeguarding of public health, and, lastly, the place of scientific medicine and the need for the co-operation of the laity in its furtherance.

That these points already are of general interest to the citizens of these fourteen states is indicated by the voluntary lay attendance at the public gatherings. Their interest has been not one of curiosity but of definite search for information. It is evident that the public is anxious to know more of hospital betterment in order to utilize this information; it is interested in scientific medicine in order to avoid unscientific medicine, and to assist with its influence in the furtherance of real research at the cost of sentimental prejudice.

The labors of the College as presented to the laity have evidently won for the College and for its program a permanent and understanding appreciation. It is to be hoped that this appreciation will express itself in the furtherance of the College program for the safeguarding of public health through local, civic, county, and state lay organization. Definite work toward this end is much to be desiderated, both through the suggestion as to the objects that may be accomplished by the laity and the methods, possibly, through which organization to this end may be effected in a purely civic way.

SCHEDULE OF SECTIONAL MEETINGS FOR 1922

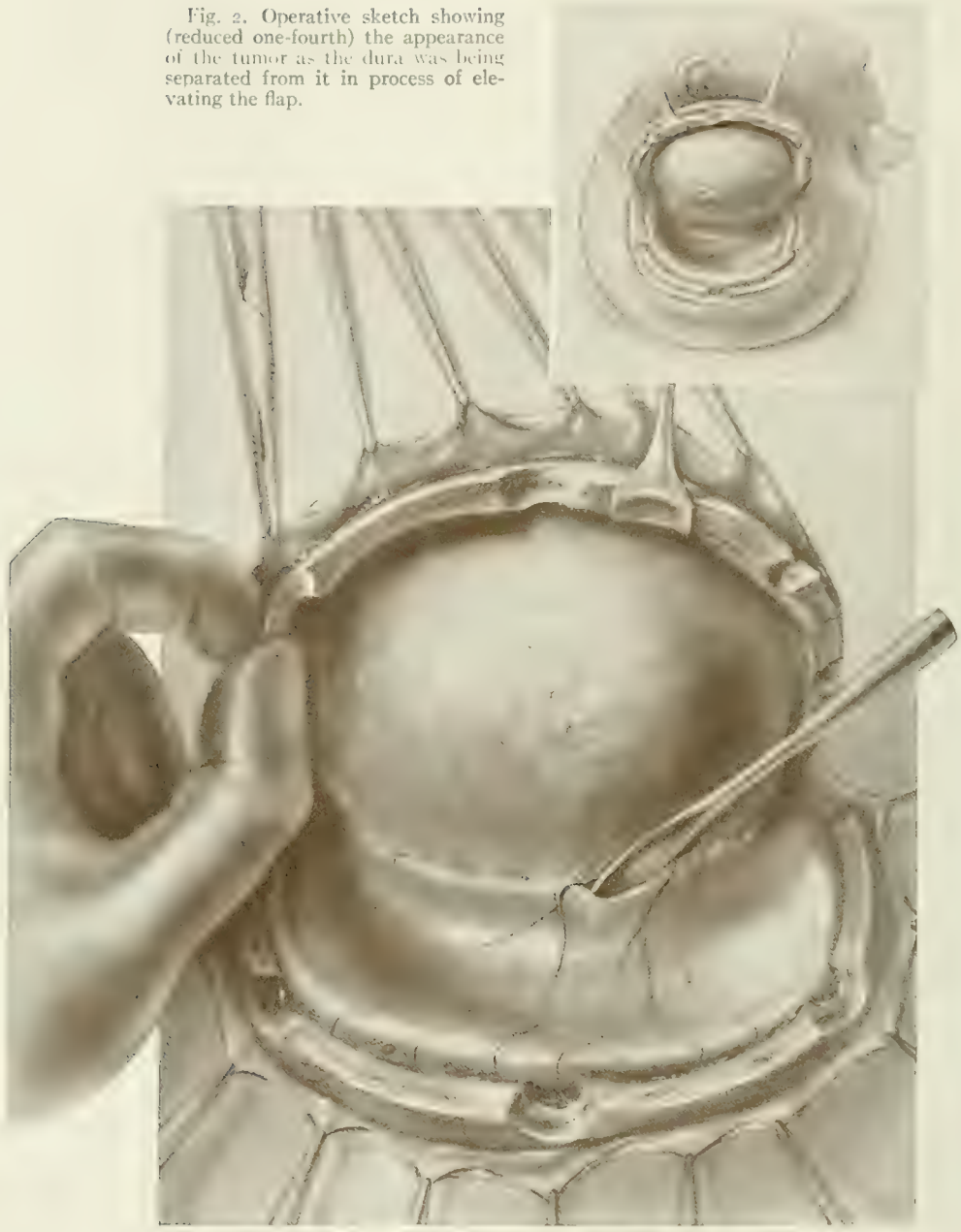
Pennsylvania, Delaware, and New Jersey at Allentown-Bethlehem, Pennsylvania, April 3-4.

Quebec at Montreal, Quebec, May 11-12.

New England States at Portland, Maine, May 15-16.

Nova Scotia, New Brunswick, and Prince Edward Island, at Halifax, Nova Scotia, May 19-20.

Fig. 2. Operative sketch showing (reduced one-fourth) the appearance of the tumor as the dura was being separated from it in process of elevating the flap.



Large Epidermal Cholesteatoma of the Parietotemporal Region Deforming the Left Hemisphere without Cerebral Symptoms.—Harvey Cushing.

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A LARGE EPIDERMAL CHOLESTEATOMA OF THE PARIETO-TEMPORAL REGION DEFORMING THE LEFT HEMISPHERE WITHOUT CEREBRAL SYMPTOMS[1]

BY HARVEY CUSHING, M.D.

Professor of Surgery, Harvard Medical School

CHOLESTEATOMATOUS masses in the temporal bone usually ascribed to otitis media desquamativa are not particularly uncommon, and in the various journals devoted to otology there may be found from year to year the report of one or more cases. They are generally regarded by writers as something apart from the true cholesteatomata or pearly tumors which are encountered elsewhere within the cranium.[2] Though from my reading on the subject I am inclined to believe that this view may be erroneous, the matter need not detain us, for this presentation is concerned with a cholesteatoma which obviously had no connection with the middle ear.[3]

The cholesteatomata remote from the temporal bone are unusual tumors and certain types of them excessively so. They are so uncommon, indeed, and excite so much interest when disclosed unexpectedly post-mortem, or more rarely in the course of an operation on the brain, that they are prone to find their way into medical literature. So far as I am aware, the condition has never been diagnosed except at autopsy or operation. Certain of these lesions, however, despite their obscurity, should be quite capable of recognition because of the characteristic changes in the bone which the X-ray may disclose. This was true of the case to be presented.

In the history of these tumors there are three names with which all articles on the subject usually begin—those of Cruveilhier, of Johannes Mueller, and of Virchow—though that of Esmarch possibly deserves to be added to them. In his famous *Anatomie*

[2] There has been no satisfactory key-word for these lesions. Paget's designation of "cutaneous proliferating cyst" is probably the best, but its length is prohibitive. "Pearly tumor" merely describes the striking surface appearance of the leptomeningeal tumors which lie free of attachments. Mueller successfully rubricated the equally insufficient term "cholesteatoma" based merely upon the crystalline depositions in the central fatty mass. Virchow endeavored to replace "pearly tumor" by a term from the Greek, namely, "margaritoma," which did not survive. *Cholesteatoma* seems likely to remain, for it probably conveys most to most people.

[3] It is my impression that many of the cholesteatomata reported by otologists are true epidermoid tumors of the sort under discussion, which originate from aberrant epidermal "rests," laid down in the temporal bone during the early formation of the complicated special sense organ which it contains. Certainly all of the tumors which have a demonstrable epidermal membrane such as those encountered more often in the mastoid process and which may reach a considerable size, are in all likelihood actual Cruveilhian tumors. It is not improbable, indeed, that in many of the recorded cases the cholesteatoma itself was responsible for the otitis media, rather than the reverse. Excessive desquamation of epidermoid cells which have grown from the canal into the middle ear in a long-standing case of otitis media may doubtless occur and produce a pseudo-cholesteatoma, but another explanation of the process seems the more likely for the majority of the cases. The tumors are said to vary in size from a hemp seed to a walnut and their most frequent situation is in the mastoid process, the upper portion of the tympanic cavity, and the external attic. From these points as the cystic growths enlarge, they cause pressure absorption of bone with ultimate lodgement of the lesion between skull and dura. A typical example of a walnut-sized epidermal cholesteatoma of the mastoid is shown in Politzer's "Diseases of the Ear."

For those who would pursue this subject, attention may be called to a most important discussion which has been rarely quoted but which took place at two sessions of the Berlin Medical Society early in 1889. Virchow at this time gave at length his ideas concerning these tumors, which he regarded as common. He had found "Perlgeschwuelste" in 15 out of 53 consecutive cases of fatal otic suppuration which had come to autopsy (Perlgeschwuelste des Felsenbeins, etc. Berl. klin. Wchnschr., 1889, XXVI, 216 and 250.

[1] Case presented to the Boston Society of Psychiatry and Neurology at a meeting at the Peter Bent Brigham Hospital, January 2[illegible], 1922.

Pathologique (1829), Cruveilhier pictured and described one of these tumors which, happening to be of the leptomeningeal form with a highly refractile and nodular surface, he named "*tumeur perlee.*" Two examples of the same kind of tumor had previously been recorded by Leprestre and by Dupuytren with sufficient clearness to make them capable of identification. A wax preparation of Dupuytren's case is in the collection of the *École de Médecine.*

In 1838 Johannes Mueller[1] described three cases, and gave the name "cholesteatoma" to the lesions. Curiously enough, one of them was an example of the exceptionally rare type with which this paper is concerned: a tumor which apparently arose in the diploe and involved the upper middle portion of a hemisphere, having destroyed the inner table of the skull.

Finally, in 1855, Virchow returned to the term "pearly tumor" in an article[2] in which nine cases were discussed, two of the temporal bone and three of the basal arachnoid. The other four tumors which he included because of their cholesteatomatous contents occurred elsewhere in the body (breast, testis, etc.), and need not be considered in our present connection.

The following year (1856) Esmarch[3] gave a brief account of what appears to have been the first intracranial cholesteatoma surgically treated, a tumor of the frontal region, the growth having apparently arisen from the bones of the cranial vault.

Since these early papers, such articles as have appeared under the title of cholesteatoma have, for the most part, been devoted merely to individual case reports, though some of the more important of them, those for example by Benda, by Benecke and by Bostroem, enter fully into a discussion of the nature and origin of the lesions.

Since von Remak first expressed the opinion in 1854 that these growths were due to epithelial "rests," a number of different views have been advanced concerning them. In his original paper Virchow classified them as heterologous tumors arising in the connective tissue, and though it would appear that he regarded them as epithelial, he confused contemporary readers by likening them to cancroid. Several of his followers (Glaesser, Benecke, and others), attributed them to an endothelial anlage, an opinion which can only be explained on the basis that a variety of tumors with scant regard for their origin or histology, whether endothelial, epithelial, or otherwise, came to be called cholesteatomata after Mueller had coined the term, for the simple reason that they contained deposits of cholesterin crystals.

A familiar example of this is the so-called cholesteatoma of the choroid plexus which Klebs properly regarded as endothelial in origin. Though found also in man, they are far more familiar to comparative pathologists, and the only example I have seen was in the brain of a horse, the specimen having been given me by Professor Theobald Smith. These intraventricular tumors are in no sense comparable to those which we are considering, and Blumer's designation of them as "cholesteatomatous endotheliomata" is the proper one.[4]

Certain of the suprasellar cysts of pharyngeal (Rathke's pouch) origin offer another illustration of the misuse of the term. For cholesterin crystals are precipitated in the fluid contents of some of these cysts and though they unquestionably originate from epithelial "rests" dating from an early period of development, these inclusions are of pharyngeal rather than of cutaneous origin and have fluid contents in place of the fatty mass of desquamated cells of the cholesteatoma proper.[5]

All this merely shows how unsatisfactory the term cholesteatoma really is unless all are

[1] "Ueber den feineren Bau und die Formen der Krankhaften Geschwuelste." Berlin, 1838, i, Lief., 49-54. They were discussed by Mueller under the general title "*Von der geschichteten perlmutter glaenzenden Fettgeschwulst; Cholesteatoma*" and were regarded as a subgroup of fatty tumors which comprised (1) the lipomata, (2) the fat cysts, (3) cholesteatomata. He described as cholesteatomata, tumors elsewhere than in the cranium.

[2] Ueber Perlgeschwuelste. Arch. f. path. Anat., etc., Berl., 1855, viii, 369-416.

[3] Esmarch, Fr. Cholesteatoma im Stirnbein. Arch. f. path. Anat., etc., Berl., 1856, x, 307-316.

[4] G. Blumer. Bilateral cholesteatomatous endotheliomata of the choroid plexus. Johns Hopkins Hosp. Rep. (Welch Festschrift), 1900, ix, 279-290.

[5] There have been 28 surgically verified pharyngeal pouch (suprasellar) cysts in my tumor series, and in several of them cholesterin crystals were present. It should be said in this connection that the cyst wall of three of these tumors which were histologically examined by Bailey contained keratohyalin granules, which suggests a dermal origin (P. Bailey. Note concerning keratin and keratohyalin in tumors of the hypophyseal duct. Ann. Surg., 1921, lxxiv, 501-505). However, in only one of the 28 cases did the cyst in other respects resemble the traditional cholesteatomata.

agreed to restrict it to tumors of a given type and origin, or else to modify the term by indicating whether the growth is endothelial or epithelial in origin.

If we confine ourselves to the true epithelial cholesteatomata and to those originating in the the cranial chamber elsewhere than near the ear, they are found to represent only a fraction of one per cent of intracranial neoplasms as a whole. In my own series, consisting at the present writing of 740 histologically verified tumors, there have been, including the present case, only three examples, so that they represent less than half of one per cent of all tumors. This corresponds approximately with the figures given in the tumor series of Tooth, of Bernhardt, and of others.

Two of these cases have already been reported by Dr. Percival Bailey[1] as examples of Cruveilhier's "Tumeurs Perlées." The lesion in one of the patients apparently originated between the cerebellum and the roof of the fourth ventricle and gave a definite cerebellar syndrome. Dr. Bailey was able to find in the literature only eight similar cases, all of them having been postmortem findings. In the other patient the lesion was suprasellar, situated below and deforming the third ventricle.[2]

The characteristic, glistening, mother-of-pearl appearance of the surface of a cholesteatoma is seen at its best in the case of these median subarachnoid tumors which have no connection with the dura or bone. They are of most variable size and occasionally may attain such dimensions, reaching from chiasm to foramen magnum, that their meningeal point of origin cannot be determined.

At the time of Dr Bailey's report we had not seen any intracranial cholesteatomata other than those of the Cruveilhier type, but since then two examples of typical "pearly tumor" which, however, were hair-containing have been met with. It is evident, therefore, that these lesions, which beyond question are of cutaneous origin, may arise either from an epidermal or dermal implantation. This opinion coincides with that of Bostroem of Giessen, who in 1897 published one of the most thorough analyses of the subject. He reported two cases of his own, one a true *epidermal* cholesteatoma, and the other a hair-containing, or *dermal* cholesteatoma,[3] both of them arising from the leptomeninges.

It is important to bear in mind, therefore, that the intracranial cholesteatomata which show the characteristic mother-of-pearl surface may or may not be hair-containing, depending upon whether the original epithelial inclusion consisted of the malpighian layer alone, or of the whole skin. It would appear from my series that one variety is as common as the other.

From what has been said, it is evident that the more common situations of the so-called cholesteatomata are (1) in and about the temporal bone; (2) free in the leptomeninges of the cerebral base; (3) in the cerebral ventricles, these last being endothelial tumors.

In still another situation, typical cholesteatomata may occur, namely in the bones of the skull at places remote from the middle ear. Under these circumstances, as is also true of the tumors encountered by the aurist in the temporal bone, the glistening surface of the growth is obscured by its environment. Nevertheless, its characteristics, gross and microscopic, are otherwise the same as in the leptomeningeal tumors. These growths, judging from the few cases which have been reported, appear to be of the epidermoid variety alone. They seem to originate between the two tables of the skull, the inner table being the first to become ballooned out and absorbed as the growth enlarges. Such a tumor is represented by the lesion found in the following case.

CASE REPORT

P.B.B.H. Surgical No. 13640. *December* –, *1920*. Admission of Mr. , an army officer, age 40, an alert, active individual with the complaint of slight dragging of his left foot.

Family history. Excellent, except that his mother died from malignant disease.

[1] Bailey, P.: Surg. Gynec. & Obst., 1922, xxxv, 496–504.

[2] Since writing this note there has been another epidermal cholesteatoma exactly like the first of the cases which Dr. Bailey described. The tumor occupied the roof of the fourth ventricle, distending the iter and producing hydrocephalus. This makes a percentage of approximately one half of one per cent for these lesions, or one per cent if the dermal as well as the epidermal cholesteatomata are taken together. It is quite possible that a good many of these tumors may be overlooked in an ordinary cerebellar exploration. The tumor in this last case was disclosed by accident, on pulling up the cerebellar tonsils which had herniated into the spinal canal, after a thorough exploration of the posterior fossa in and around the cerebellum had been regarded as negative.

[3] Bostroem: Ueber die praden Epidermoide, Dermoide und Lipome und duralen Dermoide. Centralbl. f. allg. Path. u. path. Anat., 1897, viii, 1–8.

Past history. Always strong and vigorous with good habits. Graduate of a military academy in 1898, where he stood above the average in his class. Diphtheria in 1908. A glancing bullet wound of occipital region in 1910. Tropical dysentery in 1915. A fall from a horse in 1916 with some transient concussion. A hæmorrhoid operation in 1918. All his life he had had a slight impediment of speech in the nature of a lisp.

Present illness. It was somewhat difficult to know when this began, if indeed his symptoms may be called an illness. He was inclined to date his troubles to the fall from his saddle which occurred in *March, 1916*, at which time he struck his head and was stunned for a few minutes, but was otherwise not inconvenienced nor was his work interrupted. There was no contusion of the scalp.

Four months later (July) he happened to observe that there was a small depression in the left temporoparietal region which was slightly sore on pressure. This slight defect or indentation in the skull, naturally attributed to his fall, has slightly increased until it now will almost take the tip of the little finger. *In September, 1916*, when ordered up for promotion, note was made of this condition by the examining surgeon. During 1917 he was busy organizing a regiment. Apparently he did not always agree with the opinions of his superiors and consequently was regarded as being eccentric.

In *May, 1918*, he was ordered before an examining board. At this time an X-ray was taken of the skull which revealed the same curious appearance to be described as present 2 years later. He passed all physical and mental tests without difficulty and in *July, 1918*, was sent to France. After 3 months' hard work overseas he became much run down. He was examined and was said to have a psychoneurosis. Consequently he was relieved from duty, sent to a hospital, and invalided home.

In *November, 1918*, another X-ray was taken which showed the peculiar defect in the cranial bones to be unchanged. A war-made neuropsychiatrist found him "hyper-active" and he was given 3 months' leave. He reported before the expiration of this time, was re-examined, again successfully passed all mental and physical tests above the average, and was returned to duty.

For the next 18 months he was in active service on the Mexican border but did not stand the heat well during the summer and again became run down. At this time he was reclassified and put in Class B by a board of officers but he successfully fought the action of the board and was reinstated.

In *September, 1920*, for the first time he had some discomforts—vague pains in the back of his neck. He was again examined, and found to have some weakness in his *left* hand and a slight drag of his *left* foot. A diagnosis was made of "paresis with osteoporosis." Three spinal punctures were performed, but tests of the fluid were negative. A month later he was ordered up for another neuropsychiatric examination and the diagnosis of "paresis" was confirmed and he was recommended for retirement.

For the past month there has been for the first time a slight sense of soreness or discomfort in the region of the cranial defect and he has detected a slight pulsation there.

These are perhaps the essentials of the long story, told by the patient with a most unusual preciseness and clearness of memory for dates and incidents. The general physical and special neurological examinations, with the exception of two things, were absolutely negative. These were (1) the cranial lesion disclosed by the X-ray over the left hemisphere, mentioned in the history as having been first observed 2 years before, and (2) the slight neuromuscular disturbance on the same —the *left*—side of the body. He is right-handed.

There was otherwise nothing. Fields of vision, eye grounds, ears, hearing, body fluids—all were normal. In view of the history, interest naturally centered on the patient's mentality, but so far as could be determined there was nothing which could be regarded as abnormal. A man of strong personality, of active mind, alert, perhaps somewhat impatient, opinionated and aggressive, he apparently had not always suited his possibly more phlegmatic superiors who regarded him as prone to assume responsibilities before they were allotted to him. These traits appear to have occasionally made trouble for him and to have aroused the enmity of certain fellow officers.

He had, as stated, an exceptionally accurate and retentive memory; he was co-operative, interested, made friends easily—in short, showed no stigmata of mental deterioration or variation from the normal, other than what personality might account for. He was inquisitive about his condition rather than introspective and was not at all neurasthenic.

I. The changes in the skull. (Fig 1.) The X-ray showed an extraordinary quadrilateral area of bone absorption over the left side of the skull, measuring about 3.5 inches on each side, resembling on the plate the appearance which might have been left by an old craniectomy. The somewhat irregular and wavy outlines of the defect were sharply demarcated

Fig. 1. Roentgenogram of left cranium (reduced one-half) showing bone defect. Point of complete absorption at *a*. Scale of bone at *b* from inner table, shown by stereoscope to be on edge and well within cranial chamber.

and the area showed irregular patches where the bone had undergone almost complete absorption. In the center was a small trifolate patch corresponding to the tender spot near the temporoparietal suture, where palpation revealed a defect in which there was slight pulsation (Fig. 1. a). The external surface of the skull appeared otherwise to be normal. Stereoscopic studies showed that the sharply cut margin of the defect had a raised border projecting slightly within the chamber; also that there was a thin, isolated scale of bone corresponding to the posterior border of the lesion which stood away from the bone defect perpendicular to the surface and well within the cranial chamber (Fig. 1, b).

This appearance could only be explained on the ground that there was a large growth of some kind within the skull, but how a lesion of such a size, in this situation over the left hemisphere, could have produced such a degree of pressure atrophy of the bone without some evidence at the same time of cerebral involvement was inexplicable. A lumbar puncture needle was inserted through the small bone defect without finding fluid. In its lumen on withdrawal was a little yellowish material which, under the microscope, resembled degenerated epithelial cells.

2. *The positive neurological findings.* The slight weakness and awkwardness of the left foot of which the patient complained really amounted to little, but the deep reflexes on the left side were unquestionably more brisk than the right. Occasionally an ankle clonus was elicited on this side, though never a positive dorsal toe response, the character of the left plantar reflex being somewhat obscure.

These symptoms, homolateral to the cranial defect, were a source of confusion before the operation, nor can they even now be satisfactorily explained. Suffice it to say they disappeared immediately afterward.

There were two considerations which made it difficult to decide just what, if anything, should be done in the way of an intracranial

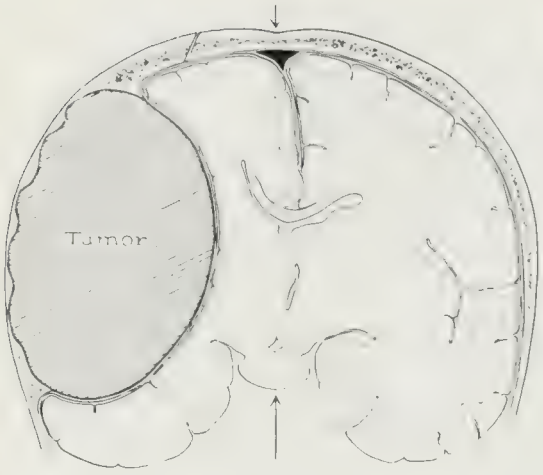

Fig. 3. Drawing to scale, representing on coronal section the position of the tumor within the skull. (Reduced one-half).

exploration. In the first place, was there, in addition to the obvious lesion over the left hemisphere, actually a process of some sort in the upper part of the right hemisphere responsible for his left-sided symptoms and increased reflexes? In the second place, was there actually a lesion demanding surgical measures on the left side, in view of the absence of contralateral symptoms, and, if so, how could it be safely explored without breaking into the area where the skull was greatly thinned? It was finally decided to outline and reflect an osteoplastic flap with a sufficient margin beyond the defect, to avoid, if possible, breaking into it. It was felt that, if a large tumor or cyst capable of enucleation should actually be disclosed, a most unsightly depression would be left if, in the process of its exposure, the egg-shell area of bone should happen to be damaged.

December 14, 1920. Operation. Osteoplastic resection. Disclosure of large cholesteatoma. Separation of tumor from dura and skull. Complete enucleation. Opening of dura with separation of adhesions. Closure without drainage.

A flap was outlined so as to allow for a half-inch of normal bone beyond the defect. Six to eight perforations were made but there was a good deal of difficulty in connecting them, owing to unusual bleeding from the diploe as well as from the numerous Pacchionian bodies projecting into the skull.

The bone incision was finally completed and the flap was tilted upward slightly, care being taken in this manœuvre that it should fracture well down in the temporal region. On looking under the slightly raised margin of the flap one could see that the dura was pulled up and was slightly adherent to the surface of a tumor. It was possible by careful dissection to separate from the tumor what proved to be an exceedingly thin dural membrane, there being a second membrane which remained adherent to the tumor. The thin dural membrane was brushed away from the surface of the tumor as the bone flap was slowly elevated, carrying the tumor with it (Fig. 2, frontispiece). On the inner surface of the growth between it and the dura were encountered a few thin flakes of distended inner table, in addition to the chief fragment on the posterior side which had been disclosed by the X-ray.

Fig. 4. Photograph of patient on discharge: to show situation of flap.

The tumor proved to be of unexpectedly large size, and at a late stage of the elevation of the bone flap the heavy growth began to sag away from its insecure attachment to the bone, so that the whole mass, together with the flap, was held up by a gauze hammock. The flap, together with the tumor, was finally lifted up intact from its pocket in the hemisphere covered now by the sagging dura.

The growth was very loosely attached to the irregular shallow cup it had made for itself in the bone and was separated without difficulty, though during this process the surface of the friable lesion was somewhat fragmented. The outer margin of

Fig. 5. The tumor mass (natural size).

the cup in which it lay consisted of a sharp ridge of bone which projected a few millimeters on to the side of the tumor in its entire circumference, accounting for the distinct peripheral shadow in the X-ray. This ridge was subsequently rongeured away so as not to leave a projecting edge on the under surface of the skull.

The portion of the flap corresponding to the area of absorption was very carefully cleared of all tags of tumor membrane, which being but slightly adherent were easily wiped away. The under surface of the bone showed a very much greater degree of absorption than had been anticipated in view of the X-ray findings, there being several irregular areas where no bone whatsoever remained, but merely a dense membrane.

A small opening was made in the thin, collapsed dura with the intent of floating it up by the injection of salt solution. This procedure revealed the fact that in the central portion of the exposed field there was an adhesion between dura and brain. Consequently the membrane was incised, disclosing a non-pulsating hemisphere which showed a concave depression of amazing dimensions. It was found that the centrally placed adhesion was a vascular one, there being a large vein and two small arteries uniting dura and brain. They were divided between clips: the membrane thus freed was closed and floated up with salt solution. The bone flap was replaced and closed in layers without drainage. A schematic representation showing the size and position of the growth on coronal section is given in Figure 3.

Recovery was uneventful. The wound healed perfectly (Fig. 4). The symptoms referable to the left side promptly disappeared and were possibly due to some distant effect of the growth difficult to explain. The patient was discharged *January 3, 1921*, and has remained well. So far as can be told at this writing, a year later, there has been no change whatsoever in his personality.

Pathological note. The tumor (Fig. 5) is a large, roundish mass the size of an adult fist. Its weight is

Fig. 6. Cholesterin crystals and fatty cellular mass from cyst contents.

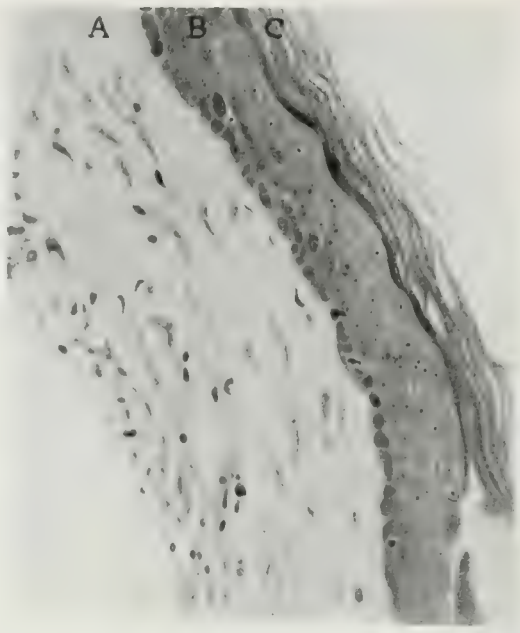

Fig. 7. Section of cyst wall (× 250) showing (a) the fibrous zone, (b) the zone of epidermal cells, and (c) lamellæ of desquamated eipithelium.

175 grams and its measurement about 4 inches in diameter. Attached to its inner surface is a thin, fibrous membrane resembling a pseudo-dura. On removing this, the tumor proper shows the glistening pearly surface of a cholesteatoma, though less perfect than in the case of tumors which lie freely in the cranial chamber. The outer surface of the growth, which lay against the bone, has been somewhat fragmented in removal and the scale-like masses of desquamated fatty epidermis are somewhat broken apart.

Histological note. Between the friable lamellæ of fatty degenerated cells arranged more or less concentrically and constituting the central portion of the growth, cholesterin crystals are present in great numbers (Fig. 6). The thin membranous capsule of the tumor consists of an outer delicate zone of vascularized fibrous tissue, whereas the inner zone is made up of four to five layers of polygonal epidermoid cells with normal staining reactions. (Fig. 7). Keratohyalin granules are demonstrable but no eleidin granules are found. The capsule appears to contain no papillæ, nor are hairs present in the central mass.

As previously stated, the cholesteatomata arising from the leptomeninges have usually been unexpected postmortem findings, and most of the treatises which deal with them have been presented by pathologists. Their surgical aspects have rarely been considered. Tooth's report[1] of the 500 cases of tumor observed at the National Hospital in Queen's Square gives two examples which had been operated upon by Sir Victor Horsley. Both of them were extracerebellar tumors occupying the lateral recess on the right side, and they possibly may have been connected with the temporal bone. The histological study of the lesion was inconclusive, for the tumor mass in both cases was incompletely removed with a spoon and the lining membrane not secured

On the other hand, the extradural cholesteatomata, which seemingly arise from between the tables of the bones of the skull as in the case here reported, have not infrequently been subjected to operation, and with the exception of the early reference to an occipital cholesteatoma by Johannes Mueller, the few cases in the literature seem to have been reported by surgeons. The operations have not been particularly satisfactory ones, as the tumor mass has usually been entered through

[1] Tooth, Howard. The treatment of tumors of the brain and the indication for operation. Tr. XVII Internat. Cong. Med., 1913, Sect 11, 161-257 (Cases 244-245).

the bone defect and the complete eradication of its lining membrane has been rendered thereby well-nigh impossible. Though a more extensive search might reveal additional case reports, those of which I am cognizant are as follows:

1. *Esmarch's frontal case.*[1] A fluctuating, slowly growing tumor of hen's-egg size in the left frontal region of a man, age 24, present for 14 years. Both tables had become completely absorbed and the tumor was surrounded by a sharp bony edge and presumably originated in the diploe. The tumor was operated upon. Fragments of its inner membrane were incompletely separated from the dura. The cavity was packed. Recovery.

2. *Weinlechner's frontal case.*[2] A man of 45 who had received a blow on the forehead at 8 years of age. A tumor developed, producing epilepsy. Two operations were performed; the first was followed by suppuration. The tumor had led to a small area of pressure absorption of the outer table and extensive absorption of the greatly distended inner table. Drainage; recovery.

3. *Wotruba's frontal case.*[3] A man, age 22, with a right frontal tumor of goose-egg size deforming the right eye and causing severe headaches. The overlying bone had become absorbed and at the base of the large tumor cavity the internal table was likewise largely absorbed. The cholesteatomatous mass was scooped out through the defect but the inner membrane adhering to the dura could only be removed in fragments. Drainage; recovery.

4. *Blecher's frontal case.*[4] A 24-year-old workman had, as a child, received a blow on the left side of the head in the parietal region. A local swelling developed, which in time enlarged to the size of a hen's egg and became soft and fluctuating. It was demarkated by a sharp bony edge. It produced headaches. There was no pulsation. At the operation the central mass was scooped out, leaving a large cavity lined with a bluish-white skin which, by pincers and curette, could only be incompletely removed piecemeal from its attachments to the dura. Recovery.

5. *Borchardt's occipital case.*[5] A 46-year-old workman had received a trifling scalp wound in the occiput. Headaches followed, and shortly after a palpable defect was observed in the occipital bones. It was tender but without pulsation. It produced general pressure symptoms with choked disc and a cerebellar localizing syndrome. Operation revealed a large extradural cholesteatoma weighing 90 grams.

6. *Koerner's occipital case.*[6] A man of 41 had for years suffered from suboccipital headaches. A semi-fluctuating swelling developed low in the left side of the occiput in which one could feel the margin of a bone defect. Operation revealed a large cholesteatoma whose contents were scooped out. Recovery.

These few cases abstracted here, including my own, show three frontal, two parietal, and, with Mueller's case, three of the occipital region. There are a few other cases referred to in the literature, the original reports of which have not been identified. Such for example is Pfannenmueller's case mentioned by Bergman as occurring in the temporal region[7], and also Benda's cerebellar case reported in 1897 before the Berlin Medical Society.

These cases constitute a group of true epidermal cholesteatomata which are extradural and appear to originate between the two tables of the skull. The tables become separated, thinned by pressure, and finally absorbed, the inner table as a rule suffering more than the outer. In all former instances the cystic mass has been intentionally opened early in the operation and, as Blecher remarks, the extirpation of the growth *in toto* is impossible under these circumstances owing to the fact that the membrane adheres to bone and dura, which makes a recurrence probable. Unquestionably the removal of the epidermal membrane is the crux of the procedure and this can only be accomplished before the cyst is emptied of its contents and its enveloping membrane permitted to collapse. Incomplete removal of the lining wall is doubtless the explanation of the recurrences so common after operations by otologists for the cholesteatomata of the temporal bone which come almost solely into their province.

To summarize: It may be said that the cholesteatomata or pearly tumors proper arise from epithelial implantations which occur in the development of the embryo. They are seen in their most typical form in the leptomeninges, more commonly between the cerebellum overlying the fourth ventricle, and in the infundibular region. They also occur in the cerebellopontile recess, and in the Sylvian

[1] Loc. cit. 1886.

[2] Reported at a session of the K. K. Gesellschaft der Aerzte in Wien. Wien. klin. Wchnschr., 1889, Feb. 14, No. 7, p. 136.

Ueber ein Cholesteatom im Stirnbein. Wien. klin. Wchnschr. 1889, Nov. 21, p. 889.

[3] Ueber Cholesteatome Epidermoide der Schaedelknochen. Deutsche Z. schr. f. Chir., 1925, lxx, 352-362.

Cholesteatom der hinteren Schaedelgrube. Arch. f. klin. Chir., 1925, cxxxvii, 892-899.

[4] Ein Cholesteatoma verum in der hinteren Schaedelgrube. Ztschr. f. Ohrenheilk., 1930, xxxvii, 352.

[5] Pfannenmueller: Inaugural Dissertation. Giessen, 1896 (not verified).

cleft. These epithelial implantations may be either epidermoid or dermoid. Hair-containing tumors when arising in the leptomeninges may have all the external characteristics of the typical pearly tumor of Cruveilhier.

The epidermal cholesteatomata, relatively common in the petrous and mastoid portions of the temporal bone, are in all probability of the same nature, for precisely similar tumors may be found elsewhere in the skull, over frontal, parietal, and occipital regions distant from the temporal bone. As the inner table of the skull becomes absorbed, these tumors though remaining extradural, may attain a large size and come to deform the brain greatly.

They are capable of recognition by the X-ray owing to the associated bone defect, and are capable also of complete surgical removal if approached by a flank rather than direct attack in order that the epidermal membrane may be peeled from the dura. This desideratum is hardly possible if the central mass is primarily opened through the defect, thereby permitting the delicate lining membrane of the sac to collapse.

THE PRESENT STATUS OF OPERATIVE OBSTETRICS REFERRING TO THE ABUSE OF CÆSAREAN SECTION[1]

By JOHN OSBORN POLAK, M.Sc., M.D., F.A.C.S., and A. C. BECK, M.D., Brooklyn

THE operative furor has surely invaded obstetrics, when even the physiological processes of normal labor are disturbed, and a normal sized child, in normal position, passing by a normal mechanism through an ample pelvis, with dilatable soft parts, is interfered with; the head disengaged, a version done and delivery accomplished by breech extraction on the plea that the woman is saved an hour or two of second-stage pains.

Other enthusiasts, either for their own convenience or to save the woman an hour or so of suffering, are routinely applying forceps when the head has reached the ischial spines, and the cervix is fully dilated; while others have so widened the indications for cæsarean section that this operation is being employed daily on patients who present no real obstetric indication for it, simply because it is the most convenient way to get the baby out.

It is the purpose of this brief paper first to review the present status of operative obstetrics, and to show that there is a difference between surgical obstetrics and obstetric surgery done for justifiable indications; second, that routine operative intervention, even in the hands of the expert, is not free from danger to both mother and child; and finally that while cæsarean section is the easiest and quickest method of delivery, there is a higher *morbidity* and a higher *mortality* following abdominal hysterotomy, than follows abdominal section generally in properly selected cases.

First, let us study the operative incidence in a series of a thousand consecutive cases, which have had intelligent and painstaking prenatal study—where each labor is conducted with a full knowledge of existing conditions, on the principle of aseptic intelligent expectancy, and where intervention is done, not withheld, on proper indications, solely in the interest of the mother or the child—and then let us compare these with 1,113 cases delivered by one man, an acknowledged expert, who has deliberately interfered with the normal processes of labor as a routine procedure.

In this series of a thousand cases there were 106 patients with actual contraction of the pelvis, an incidence of 10.6 per cent, 344 in which the occiput was posterior at the beginning of labor, and 42 cases in which the presentation was abnormal. These included 27 breeches—6 face or brow, 4 transverse, 4 sets of twins, and one complex presentation with

[1] Read before the Clinical Congress of American College of Surgeons, Philadelphia, October 20, 1921

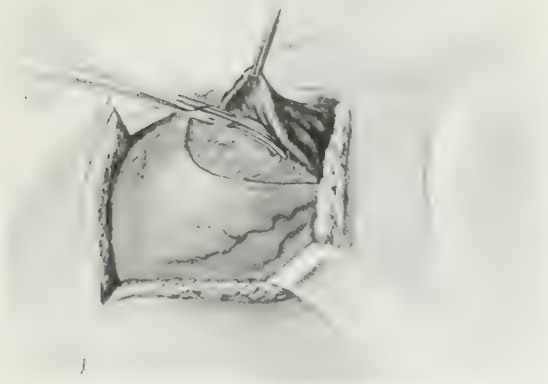

Fig. 1. Modified Kroenig cervical cæsarean section. Separation of bladder from anterior face of uterus.

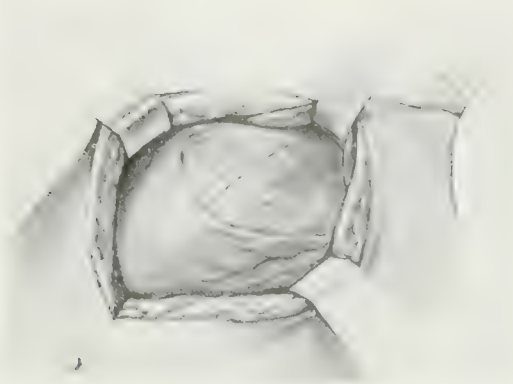

Fig. 2. Modified Kroenig cervical cæsarean section. Bladder retracted, area for incision exposed.

the head and cord presenting; yet in this series the incidence of operative intervention was as follows:

Forceps deliveries—low and median	22
Version—internal or bipolar	5
Induction of labor—by bag	1
Manual conversion of face into a vertex	2
Perforation of the after-coming head	1
Cleidotomy	1
Cæsarean section	8

This gives an incidence of forceps of 2.2 per cent, an incidence of version of 0.5 per cent, and an incidence of cæsarean section of 0.8 per cent. The number of stillbirths in this series was 19 or 1.9 per cent; including all of the infants dying within the first 2 weeks after delivery—6 more deaths should be added, making a total infant mortality of 25 in a thousand cases, or 2.5 per cent.

Compare these statistics with those published in the *transactions of the Association of Obstetricians, Gynecologists and Abdominal Surgeons* for 1920, by one of the most skillful surgical obstetricians in America.

During the year ending August 31, 1920, he personally delivered 1,113 women on whom he performed 920 versions, 39 forceps operations, and 80 cæsarean sections; or approximately one cæsarean in every 14 cases—10 women were so far advanced in labor when they were first seen that they could not be prevented from delivering spontaneously, and 12 babies were born before the attendant reached them.

In this series 41 were stillborn, and 34 died before the mother was discharged from the hospital; making a total fœtal mortality of 75, or 6.7 per cent, or nearly three times the mortality rate of the infants of the previous series referred to. Such facts leave no room for argument, they clearly demonstrate the contention that I made at the beginning of this paper, namely, that routine operative intervention even in the hands of the expert, is not free from danger to both the mother and the child.

Operative obstetrics no longer recognizes the induction of premature labor in contracted pelves, for it is admitted that induction is not free from danger; the increased danger of infection is actual, not fanciful, and complications as premature rupture of the membranes, malpositions of the fœtus, prolapse of the hand or cord do occur. Furthermore, operative intervention is required to terminate labor in a very large number of the cases (54 per cent of bag cases); this necessarily subjects the child to greater danger, not only because of its prematurity, but because it is subjected to unnecessary manipulation.

Present-day obstetric teaching recognizes the propriety of giving each case an aseptic test of labor when the pelvic deformity falls within the relative class, for over 80 per cent of these cases (8 out of 10) spontaneously deliver; or can be terminated after the head has reached the spines, by low forceps.

High forceps is an operation of history, its high fœtal mortality, and the frequent incidence of severe maternal injuries have

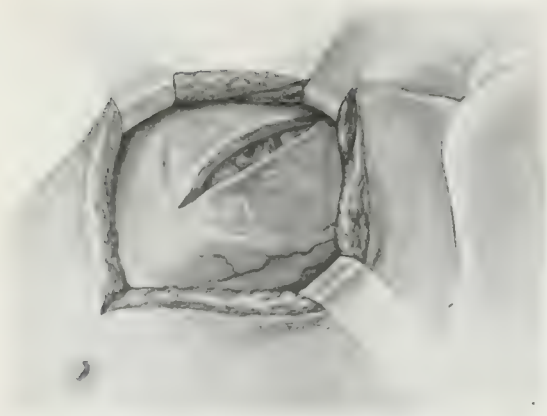

Fig. 3. Modified Kroenig cervical cæsarean section. Showing the location of the incision in the lower uterine segment.

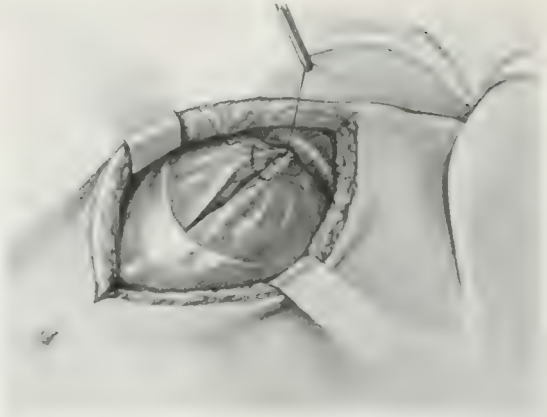

Fig. 4. Modified Kroenig cervical cæsarean section. Closing the uterine incision with a running suture of the muscle.

caused the procedure to be relegated to the atrocities of the past. On the other hand, low forceps applied with the head at or below the spines, is an operation which, when indicated, is purely life saving.

Proper attention to the action, rhythm, and rate of the fœtal heart after the membranes have ruptured and the head has passed through the cervix into the vagina, will give notice to the observing accoucher as to when a low forceps delivery should be employed, for many children lose their lives as the result of too conservative a delay during the perineal stage.

Low forceps applied under surgical anæsthesia, with the patient in the proper posture, does little or no damage to the pelvic soft parts (in the hands of a competent man).

Version according to the technique perfected and so ably described by Potter, has a wider field than has been generally given it, *but not as an elective routine procedure in normal cases*. While the majority of occipito-posterior positions of the vertex, will spontaneously rotate to the front, if the head engages and reaches the pelvic floor, and the powers are sufficient (possibly without increasing the risk). This tedious mechanism may many times be avoided by a timely version. Version, however, has its widest indication as an emergency procedure in complex presentations —brow, face, and the accidents such as prolapsed cord, placenta prævia, abruptio placentæ where rapid delivery is demanded in the interest of the child.

In present day obstetrics, embryotomy has but a limited field, and is now practically never done on the living child except in the presence of an infected mother, and even here, the Porro operation may come into competition, if there is strong necessity of delivering a living child. On the other hand, perforation cleidotomy and evisceration should have a more general use in terminating the delivery of the dead fœtus.

CÆSAREAN SECTION—ITS ABUSES

There seems to be a fallacious impression in the minds of both the general medical and lay public, that cæsarean section is a perfectly safe and simple operation which can always be guaranteed to give perfect results under all circumstances. They evidently forget the fact that *abdominal surgery always carries with it a certain risk to the life of the patient*, even in the most competent hands and under the best conditions. Hence, instead of being chosen as the operation of election after careful consideration, because it is the safest and best method of delivery for the patient, cæsarean section is looked upon by many poorly trained obstetricians and general surgeons who do consultation obstetrics, even though they do not pretend to have a working knowledge of fundamental principles of the obstetric art as a panacea for all ob-

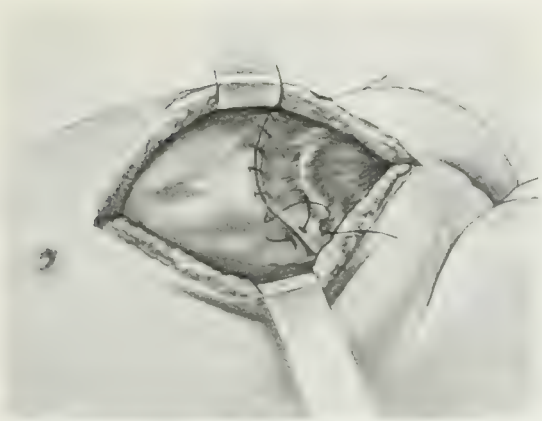

Fig. 5. Modified Kroenig cervical cæsarean section. Uterine incision in the lower segment covered with bladder reflection. Sutures being placed.

stetric ills—presumably the ease with which the operation can be performed by the average abdominal surgeon is the prime factor in the choice of suprapubic delivery in improper cases; for as compared with the ordinary obstetric operation, except perhaps an easy low forceps, cæsarean is the easiest method of delivery for the obstetrician, and the safest operation for the child.

Notwithstanding this general impression, our study of the results in 2,200 operations of which 200 are from our own clinic shows that cæsarean has a *greater morbidity and mortality than the ordinary abdominal operation* done for other pelvic conditions.

The development of the aseptic technique in surgery has made it possible to consider the rights of the child as well as the rights of the mother; hence in modern obstetrics, abdominal hysterotomy done under proper conditions by a competent operator, has been used in the interest of the child as an elective procedure in preference to some of the mutilating operations.

It may be performed as an operation of election, when a thorough examination demonstrates the fact that the child will be subjected to serious danger, in case an attempt is made at pelvic delivery, or that the health of the mother is likely to suffer seriously as a result of such a pelvic delivery. These conditions warrant the somewhat increased risk that attends an abdominal operation.

Fig. 6. Classical cæsarean section. Showing how the assistant crowds the uterus into the abdominal incision by pushing the uterus upward and forward with the hands on the sides of the abdomen.

Study of the end-results shows that those obtained by cæsarean section performed at the time of election, that is before labor begins or early in the course of labor, are much better than the results of the late or secondary operation. This therefore, *implies the necessity of very careful prenatal study, the proper estimation of the relative size of the child to the particular pelvis and the aseptic conduct of the labor,* so that if the operation is indicated it may be performed at a time when the best results may be expected for both patients.

Unfortunately, in general practice, prenatal study receives very little consideration, and most labors are conducted with questionable asepsis and repeated vaginal examinations. It is common knowledge that the majority of pregnant women are allowed to enter upon labor without any preliminary examination; the attendant having no accurate knowledge of the relative size of the pelvis or fœtus, or of the position of the fœtus; hence section is done not as an operation of election, but as an operation of the last resort, often after

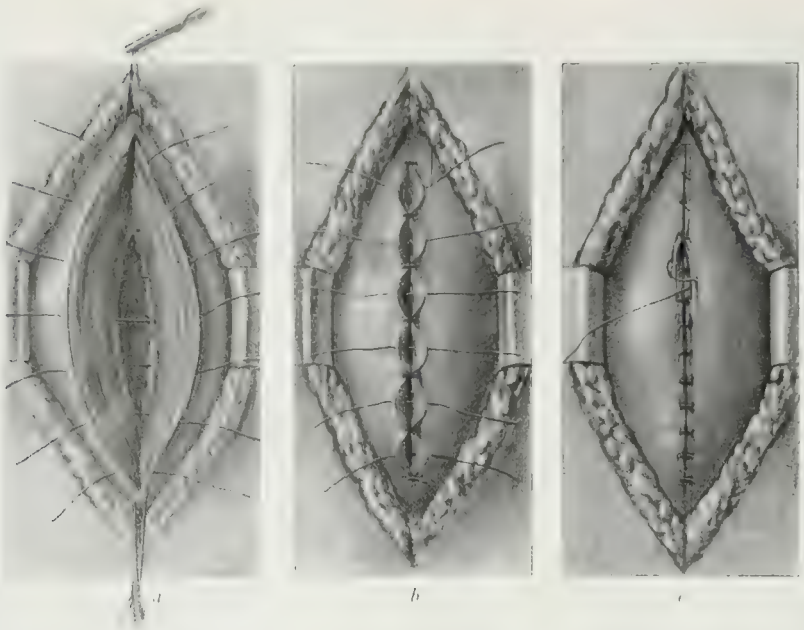

Fig. 6. *a*, Wound brought into the incision (abdominal) by traction sutures, interrupted sutures through peritoneum and muscle, just skipping endometrium, placed. *b*, Deep layer tied. Second line between each deep suture placed. *c*, Final peritonealization of uterine wound with running suture.

the patient has been subjected to repeated vaginal examinations which always open an avenue for infection; or after attempts have been made at infrapelvic delivery. These cases are potentially infected and, therefore, when section is done it is attended with a morbidity or mortality higher than should be present in properly selected abdominal cases.

Several operators can show a series of 100 or more consecutive sections without a fatality; but from a study of several thousand case reports where the operation was done by the best operators, we feel certain that their mortality will come as it has come to others.

While these surgical obstetricians have widened the indications for the use of this procedure, so that they include almost every conceivable difficulty, the obstetric surgeon is limiting the indications in both his practice and his teaching, placing its election on well-grounded indications.

Broadly speaking, the indications for abdominal delivery may be classed as those that are absolute and those that are relative. Cæsarean section is indicated in the patient in whom some definite pelvic obstruction exists either as a result of actual contraction, or by the presence of tumors blocking the pelvis which renders delivery *per vaginam* even of a dead or mutilated fœtus either impossible or so dangerous that abdominal delivery is attended by less risk to the mother.

A contracted pelvis with a true conjugate of 6 or 6½ centimeters or an immense child will give the absolute indication. This is admitted to be the only absolute indication for operation, and any operator who performs cæsarean for other reasons must be sure that the benefits which are to be expected from the operation both for the mother or the child, are sufficient to warrent the increased risk to the mother's life.

In the relatively contracted pelvis, cæsarean is considered only with a view of saving the life of the child, for in dystocia from this cause embryotomy may safely deliver from below. This leads us to the one question that should always be considered: *is it proper to*

TABLE I.—TABULATED STUDY OF TWO THOUSAND CASES OF CÆSAREAN SECTION FROM REPORTS OF OBSTETRIC CLINICS IN AMERICA (EXCLUSIVE OF LONG ISLAND COLLEGE HOSPITAL

Group I. Clean Cases	
Section	1
Maternal deaths	6
Mortality percentage	[illegible]
Group II. Potentially Infected Cases	
Section	[illegible]
Maternal deaths	[illegible]
Mortality percentage	[illegible]
Group III. Infected Cases	
Section	[illegible]
Maternal deaths	[illegible]
Mortality percentage	[illegible]

TABLE II.—AN ANALYTICAL STUDY OF TWO HUNDRED CASES OF CÆSAREAN SECTION OCCURRING IN THE MATERNITY SERVICE OF THE LONG ISLAND COLLEGE HOSPITAL, FROM SEPTEMBER 1, 1921, TO SEPTEMBER 1, 1921

[illegible] and the subjoined tables based on the results of this study.

1. Seen in the hospital before labor	
2. Referred from outside physicians	
3. Membranes	a. Intact
	b. Hours ruptured
4. Vaginal examinations	
5. Total number made	In hospital
	By physician
	By midwife
	On the outside
6. Number of hours in labor	
7. Type of operation	a. Classical
	(b) Transperitoneal
	c. Extraperitoneal (Latzko)
	Hysterectomy
8. Diagnosis	Condition demanding cæsarean
9. Puerperium	Highest temperature
	Day postpartum on which it occurred
	Number of hours above 100°
	Febrile—classes as febrile when temperature was 100.4° or more for 96 hours
	Cause of morbidity
10. Condition on discharge	

TABLE III.—THE EFFECT OF VAGINAL EXAMINATIONS ON MORBIDITY

No vaginal examinations, labor being conducted by abdominal and rectal palpation	
Total cases	[illegible]
Febrile cases	28
Morbidity	28.8 per cent
Vaginal examinations [illegible]	
Total cases	[illegible]
Febrile cases	[illegible]
Morbidity	52 per cent

These have again been divided into those in which all of the vaginal examinations were made in the hospital under strict aseptic precautions and those in which the vagina was invaded on the outside prior to admission.

Vaginal examinations in the hospital	
Total cases	65
Febrile cases	[illegible]
Morbidity	[illegible] per cent
Vaginal examinations [illegible]	
Total cases	1
Febrile cases	23
Morbidity	[illegible] per cent

TABLE IV.—THE EFFECT OF RUPTURE OF THE MEMBRANES ON MORBIDITY

	Not ruptured	Ruptured
Total cases	[illegible]	57
Febrile cases	[illegible]	42
Morbidity percentage	[illegible]	73.6

TABLE V.—EFFECT OF HOURS IN LABOR ON MORBIDITY

Operated on early in labor	
Total cases	[illegible]
Febrile cases	26
Morbidity percentage	[illegible]
Operated on late in labor	
Total cases	[illegible]
Febrile cases	[illegible]
Morbidity percentage	45.1

add that increased risk to the woman in order to save the child.

My own feeling is that the healthy unborn child has equal rights with the mother, provided she is not potentially infected, yet we cannot blind ourselves to the fact that the woman is assuming an increased risk when she agrees to abdominal delivery.

The further admitted indications may be stated as follows: Labors in multiparæ who have had previous obstetric disasters may be terminated by section, unless the present child is manifestly smaller than the previous children have been or the previous disaster can be traced to the faulty judgment or poor operative skill of the former attendant.

Placenta prævia as an indication for abdominal delivery has its advocates. We teach and practice it, when the patient is at or near term, in good condition and has not been subjected to vaginal invasion with a live child and a central or nearly total implantation of the placenta. Unfortunately these conditions rarely obtain, for the average patient with central placenta prævia has usually lost considerable blood and has had careless and unaseptic measures used for the control of bleeding, so is potentially or actually infected and is necessarily a bad operative risk.

Since Petersons' exhaustive paper on cæsarean in *eclampsia*, the operation has been frequently used to empty the uterus in eclampsia, while we occasionally employ it in the pre-eclamptic toxæmia, when eliminative treatment has failed to relieve the toxic symptoms and the obstetric conditions either in the bones or soft parts make infrapelvic delivery difficult and dangerous.

We cannot, in the light of present day statistics and the results obtained from the Stroganoff treatment, feel that abdominal delivery saves many more lives.

Abruptio placentæ is a proper, though rare indication, and then only when the birth passages are totally unprepared. In addition to these, the indication for section has been extended to breech presentation with large

TABLE VI.—MATERNAL MORTALITY

Cause of death	
Puerperal sepsis and septicæmia	5
Hæmorrhage	3
Eclampsia	4
Postoperative shock	1
Postoperative pneumonia	1
Total deaths	16
Mortality percentage	.5

16 deaths in 3200 cases

If we deduct the four deaths due to eclampsia there were 12 deaths in 3190 operations, or a mortality of 0.4 per cent.

TABLE VII.—ANALYSIS OF MORTALITY IN CLEAN CASES AND IN THE POTENTIALLY OR FRANKLY INFECTED CASES

Clean cases conducted in the hospital in which only rectal examinations were made or where a vaginal examination was done, surgical asepsis was observed.	
Total cases so conducted	148
Deaths	0
Mortality percentage	3.3
Potentially or frankly infected cases which had been handled on the outside prior to admission to the hospital	
Total cases	48
Deaths	7
Mortality percentage	14.6
All cases of both classes	196
Deaths	12
Mortality percentage	6.1

TABLE VIII.—STILLBIRTHS

Stillbirths in 200 cæsarean operations	2 or 1 per cent
Infant deaths in the first 14 days	9 or 4.5 per cent
Cause of infant deaths	
Died 1st day after delivery—maternal emergency; prematurity	2
Died first 8 hours after delivery—toxæmia prematurity	1
Died 6 hours after delivery—toxæmia prematurity	2
Died 1 hour after delivery—prematurity	1
Died 10 hours after delivery from rupture of the lung result of mouth-to-mouth insufflation	1
Died 5 days after delivery—bacteræmia	1
Died 10 days after delivery—abscess of lung	1
Total	9
Total fœtal mortality in 200 operations including those babies dying before leaving the hospital	11 or 5.5 per cent.

fœtus in elderly primiparæ; prolapsed cord with ruptured membranes, large child, and unprepared soft parts, to the delivery of the physically unfit, and in cardiacs to lessen the strain of labor, also to women in labor after previous cæsarean sections because of the danger of rupture of the hysterotomy scar, for delivery in the presence of obstructive pelvic tumors or dystocias resulting from previous suspension operations which have become uterine fixations, and in deliveries after the cervix has been amputated and the pelvic structures repaired by extensive plastic operation.

In order to demonstrate that there is actually a greater morbidity and mortality in cæsarean than attends ordinary abdominal sections, and that therefore the indication should be definite and the operative conditions favorable, we have undertaken an analysis of twenty-two hundred cases. Two thousand of this number represent the abdominal

CÆSAREAN SECTIONS

Incidence of Section in Long Island College Hospital Series

8 in 1000 or 1 to 125

Incidence of Section in Johns Hopkins Hospital Series

9+ in 1000 or 1 to 110

Incidence of Section in Potter's Series

71+ in 1000 or 1 to 14

INFANT DEATHS

Long Island College Hospital Series

25 in 1000 or 1 to 40

Potter's Series

67.3 in 1000 or 1 to 14.8

deliveries in some of the leading obstetric clinics in America; and two hundred are taken from the case records of the maternity service of the Long Island College Hospital, from September 1, 1912, to September 1, 1921.

In the first group, owing to the incompleteness of the data supplied, we have been unable to do more than compute the mortality rates.

In the series taken from the records of our own service, we have been able to make a more careful analysis, and make a study not only of the mortality but of the morbidity incident to section.

In the first group of 2,000 sections collected from other clinics (Table I), we have divided the cases into the following classes:

1. The clean case—under this head we have included all of those elective cæsareans, where the operation was done before labor, or soon after labor had begun, and in which no vaginal examinations had been made.

2. The case potentially infected—in this class will fall those patients who have had a test of labor, with ruptured membranes, and those who have been subjected to repeated vaginal examinations by physician or midwife, prior to entering the hospital.

3. The frankly infected cases, or those which have been long in labor, with ruptured membranes, careless and repeated vaginal invasions, having had futile attempts at delivery before admission to the clinic.

The 200 cases of cæsarean occurring in the maternity service of the Long Island College

Hospital, were carefully reviewed, and the foregoing tables are based on the results of this study (Tables II to VIII).

Though it may be said that our series is too small from which to draw conclusions, we feel sure that the morbidity in cæsarean is vastly greater than is found in the ordinary clean abdominal sections.

If one thinks for but a moment that the uterine wound leads directly to an infected field, it is surprising that more lives are not lost.

Our bacteriological studies of the flora of the postpartum uterus, which have lately been confirmed by Loeser, show that on the fifth and sixth day, the majority of puerperal uteri contain pathogenic organisms, which have migrated into the uterus through the open cervix from the vagina. These, therefore, are brought in direct contact with the suture line, just at the time when if there has been any defect in technique, such a faulty hæmostasis, sutures tied too tightly or carelessly placed, the wound may become inoculated, and the infection spread along the suture line. This, and the admirable culture ground offered by the placental site, are, to our mind, the reasons for the high morbidity even in clean cases.

SUMMARY

A careful perusal of the foregoing statements and of the appended tables must leave the impression in the mind of the reader—

That surgical intervention is being too freely employed to terminate labor, and furthermore that the results for mother and child from such interference (oftentimes unindicated) with the physiological processes of labor do not justify their employment.

That the adoption of the principle and practice of *aseptic intelligent expectancy* in labor, when the factors of labor are known to be normal or approximate the normal, is still the safest method of delivery not only for the mother but for the fœtus.

That there is a high morbidity even in the *clean* cæsarean section, very much higher in fact than is common in operations for pelvic tumors, such as fibromyomata and ovarian cysts. This is due to the presence of infective bacteria in the cavity of the puerperal uterus, which migrate from the vagina to the interior of the uterus, through the open cervix.

That even in expert hands there is a definite maternal risk from cæsarean section, greater than is generally known. Our mortality studies show that this ranges from 2.9 per cent to 14 per cent, depending on the time in labor at which operation is done, after rupture of the membranes and on the amount of vaginal invasion present.

And finally, in view of these facts, we feel that every pregnant woman should have greater prenatal study and care than is commonly given her, so that complicating conditions may be recognized, prevented, or corrected before labor, and where this is not possible, the knowledge gained from this study will permit the obstetrician to conduct the labor in such an intelligent and aseptic manner, as to minimize the dangers from abdominal delivery.

TRAUMATOLOGY OF THE CARPUS

By A. H. BIZARRO, M.D., F.R.C.S. Eng., London
Late Orthopedic Surgeon, Royal Herbert Hospital, Woolwich

THE surgical importance of a well-defined knowledge concerning the traumatic conditions of the wrist is obvious. An early diagnosis of conditions leads to an early appropriate treatment on which the cure so much depends. Very often the so-called "sprains," synovitis, arthritis of several kinds, rheumatism . . . of the wrist are diagnosed a long time after a possible and almost forgotten trauma such as some of the several conditions that I am bringing forward in this article. There are 123 cases of carpal injuries in this series which have been collected from cases of my own and of the Royal Herbert Hospital. These cases are much more common in practice than our traditional knowledge leads one to think. The injuries have been grouped into (a) fractures of a single carpal bone, and (b) associated carpal lesions.

FRACTURE OF THE SCAPHOID

There were 68 cases of fracture of the scaphoid, or 55 per cent of the total number of carpal injuries. These have been divided into fractures with and without extrinsic synostosis.

Scaphoid fractures without extrinsic synostosis (Diagrams I and II, *1 to 55*).

MECHANISM OF FRACTURE

	Cases	Number of figure Diagrams I and II
Fall on the hand	41	
Fall on the thumb	1	*35*
Sprain	4	*3, 38, 44, 49*
Back-fire of motors	3	*8, 21, 41*
Crushed wrist	2	*7, 32*
Fall of weight on the wrist	2	*19, 28*
Boxing punch on the wrist	2	*2, 42*
	55	

The ages of these individuals were distributed as follows:

	Cases
Between 10 and 20	0
Between 21 and 30	22
Between 31 and 40	19
Between 41 and 50	5

These cases were seen as follows:

	Cases
Within 7 days after the accident	27
Within 30 days after the accident	8
Within 6 months after the accident	13
Within 1 year after the accident	4
Within 2 years after the accident	2
Within 3 years after the accident	1
	55

Thirty-eight cases were of the right and 17 of the left hand. Three were in females and 52 in males. In one case of fracture of the right scaphoid the left os magnum was equally damaged.

Scaphoid fractures with extrinsic synostosis. There were 13 cases, as represented in Diagram III and Figure 1, which shows the ages and dates when these cases were seen. In 12 cases the fracture was due to fall on the hand and in one, Diagram III, *5*, to the back-fire of a motor.

An analysis of these 68 scaphoid fractures reveals a great variety of types of injury which can be grouped into *incomplete* and *complete fractures*. The first are usually seen at the upper border of the scaphoid and seldom at its concavity—(Diagram I, *1* to *12*). The complete fractures may be seen with or without separation of the fragments, and the absence of the synostosis of the intrinsic type is the rule among these cases even if they are seen months or years after the injury. The direction of the crack or diastasis is to be seen at the head, waist, or neck, and very seldom at the tuberosity of the bone (Diagrams I and II, *13* to *55*). In some cases there is marked comminution of the fragments (Diagram II, *26*), which is even better seen in the lateral roentgenogram of the carpus, and usually is to be noticed at the back of the wrist as a dust of bone.

The *luxation* of the fragments usually affects the upper portion which appears displaced backward or more rarely forward. The displacement is to be seen in some cases in the anteroposterior roentgenogram (Diagram I and II, *13, 14, 30*). In some rarer cases

Diagram I. Twelve incomplete, *1* to *12*, and 13 complete scaphoid fractures, *13* to *25*. Notice in this and in the following diagrams the ages of the patients (upper figures), and the time elapsed after the accident (lower figures) are given at the left hand side of the drawings.

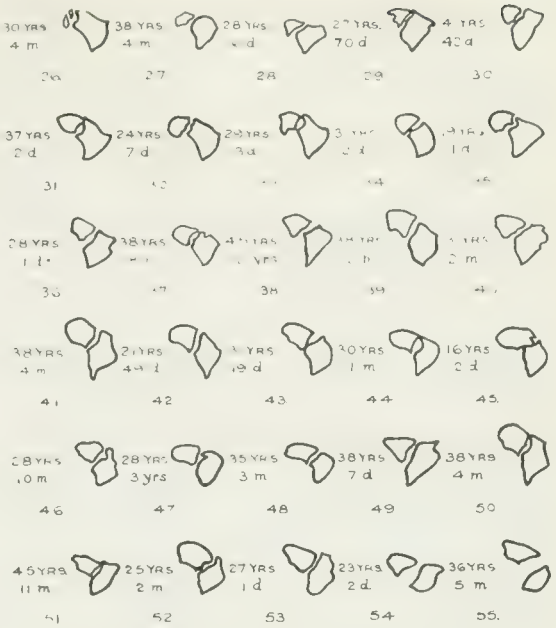

Diagram II. Thirty complete scaphoid fractures.

there is a compression of the fragments, besides the split in the bone (Diagram I, *16*, *25*). In Diagram I, *16*, the compression is not accompanied by luxation as in *25* where the lower fragment is crushed behind the upper. The more marked navicular luxations are to be seen when there is an associated carpal lesion, such as in case of retrolunar luxation of the os magnum, etc.

I have divided the synostosis into *intrinsic* and *extrinsic*. The first variety is seldom seen and corresponds usually to a prolonged period of immobilization of the wrist after the trauma (Diagram I, *22*). The average cases, however, are as shown (Diagram II, *38*, *42*, *46*, *47*, etc.) where several months and years have elapsed after the accident and yet the fragments remain completely "pseudarthrosed." Occasionally there is an attempt to union in one or more points of the line of fracture (Diagram II, *43*, *51*) which can be called incomplete union. Usually a mass of granulation tissue forms between the fragments which is shown by the cases operated upon.

The *extrinsic variety of synostosis* is commonly met with and does not necessarily mean either too long a period of time elapsed after the accident (Diagram III, *2*, *10*, and *12*), or too long a period of wrist immobilization as a means of treatment. The commonest type is the union between the distal navicular fragment and the radius. This occurred in 70 per cent of the cases (Diagram III, *5* to *13*). The next common type is where the distal navicular portion synostoses with the os magnum (Diagram III, *2*, *3*, *10*, *12*, and *13*). The proximal scaphoid fragment occasionally is synostosed with the radius or semilunar (Diagram III, *1*, *4*, *12*, and *13*), and the distal fragment more rarely still may unite with the trapezium or the trapezoid (Diagram III, *11* and *12*). The degree of functional disability is usually proportional to the extent of the synostosed areas, of which (Diagram III, *13*) is a good example, showing a severe degree of fusion accompanied by marked local swelling, pain, and limitation of movement. It is remarkable, however, that some cases display a great impairment of function notwithstanding an apparently slight lesion as was the case in Diagram II, *38*, in which there was no synostosis of any kind. The age, general condition, rheumatoid diathesis, neurasthenia, eagerness in claiming compensation, are all factors of great importance. It will be noticed that there was not among

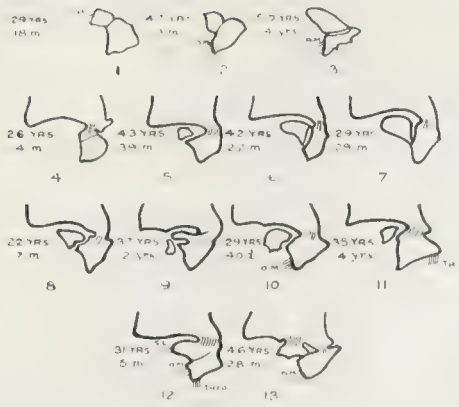

Diagram III. Thirteen complete scaphoid fractures and the varieties of "extrinsic" synostosis.

these patients a good example of cuneiform fracture of the navicular tuberosity, as in one of Blau's and Eisendrath's cases, nor any longitudinal type of crack along the bone as described by Guibout.

2, a. Fractures of the semilunar. There were two cases only—1.5 per cent of the carpal lesions. One showed a vertical, incomplete crack at the upper border of the bone, and the other was a case of compression fracture with cuneiform synostosis. The former was due to a fall on the palm and the latter to a kick from a horse.

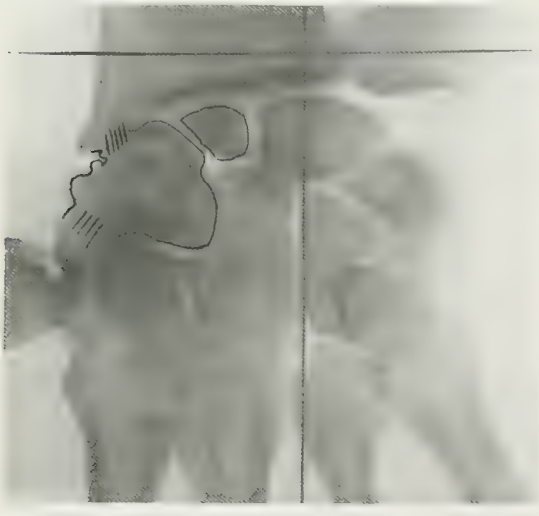

Fig. 1. This is the same case as represented in Diagram III, *11*. It is given here to make clear Diagram III.

3, a. Fracture of the os magnum. There were 6 cases, 4.0 per cent, Diagram IV. These fractures were due to falls on the palm of the hand, were all incomplete, and in 50 per cent of the cases were seen at the inner border of the neck of the bone (Diagram IV, *1* to *3*), in two cases the split occurred at the outer border and corresponding to the point of articulation with the scaphoid tuberosity, just above the capitotrapezoid ligament (Diagram IV, *4* and *5*); and, in one case it was a simple crack at the postero-inferior angle of the os magnum (Diagram IV, *6*). These cases were seen stereoscopically and this was confirmed by the lateral roentgenogram, and in some cases the opposite wrist was X-rayed as as well. The last case above mentioned was not an "os magnum secundum" but a real crack. In one case of left os magnum fracture, the right scaphoid was fractured as well (Diagram I, *13*, and Diagram V, *3*.)

4, a. Fracture of the unciform. There were four cases, 3.2 per cent, as in Diagram V. In three cases (Diagram V, *1* to *3*) the crack occurred at the outer border and inferior angle of the bone corresponding to the surface where the strong capito-unciform ligament is inserted. In one case (Diagram V, *4*), the uncus was fractured at its base, and the roentgenographic appearance was peculiar, showing a marked downward digression of the shadow of the uncus in the palmar view. They were all cases of fall on the palm.

ASSOCIATED CARPAL LESIONS

1, b. Scaphoid and radius. There were seven cases, 5.7 per cent as shown in Diagram VI. They were all due to falls on the hand, excepting Diagram VI, *6*, which was due to a back-fire. These cases produce very distressing symptoms. The radius in two cases (*4* and *5*, Diagram VI) was broken as in Vialle's fracture. In two other cases the crack (*1* and *2*, Diagram VI) occurred at the articular radial end only. In one case only the radial split corresponded to the navicular diastasis (Diagram VI, *1*, and Fig. *2*), but in two the radial crack was at the ulnar side of the center of the articular line. In one case (*3*, Diagram VI) the radial crack was seen at the outer border of the styloid only, of which *5*, Diagram

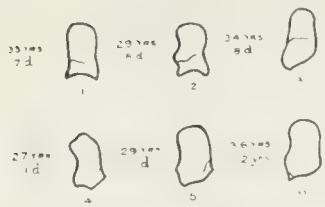

Diagram IV. Six incomplete fractures of the os magnum.

Diagram V. Four fractures of the unciform; *4* represents a fracture of the unciform process.

VI. is a more advanced condition. The case represented by *4*, Diagram VI, is, as it were, the continuation of what happened in cases represented by *1* and *2*. In *7* is shown a case of epiphyseal separation with backward luxation of the distal fragment and some navicular comminution. In none of these patients was there a fracture of the radial diaphysis as in Beck's case.

2, b. Scaphoid and ulna. There were three cases of real ulnar fracture (Diagram VII, *2*, *4*, and *5*), and two cases of ulnar styloid division. This division is in the case represented by *1* in Diagram VII, a typical "ulnare antebrachii," and in *3*, one rare example of congenital non-fusion of the styloid, os triquetrum secundum. In *2*, is shown a fracture of the styloid tip, and in this case the bony fusion is well marked in contradistinction with the congenital cases where there was a well-defined and straight gap. In cases shown by *4* and *5* in Diagram VII, there was a fracture of the lower ulnar end. In the last case the ulna was luxated backward as well, and the fall was due to a motor bicycle collision. In one case not represented in this series there was an associated fracture of both radius, ulna, and the scaphoid resembling Rutherford's case. There was not any fracture in this group resembling Potherat's.

3, b. Scaphoid and semilunar (fracture and dislocation). There were eleven cases of combined lesions. In 4 cases the naviculolunar contact was the seat of a crush which involved and compressed the contiguous portions of the two bones. In two of the above-named

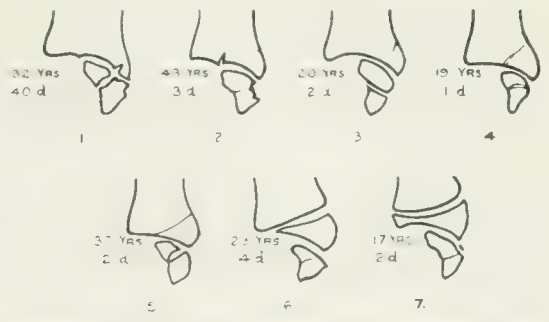

Diagram VI. Seven combined naviculoradial fractures.

cases there had been a back-fire, and in the two remaining, one fell on the palm of the hand and the last sustained the fall of a heavy object on the wrist. In 3 cases there was a fracture of the navicular head or body and crushing of the semilunar at the points of contact with the scaphoid and radius. Two of these cases were due to crushing of the wrist by heavy objects and in the third the lesions were due to a severe sprain. In one case there was radiolunar synostosis.

In another case due to a fall on the palm of the hand there was a total compression injury

Fig. 2. This is the same case as represented in Diagram VI, *1*.

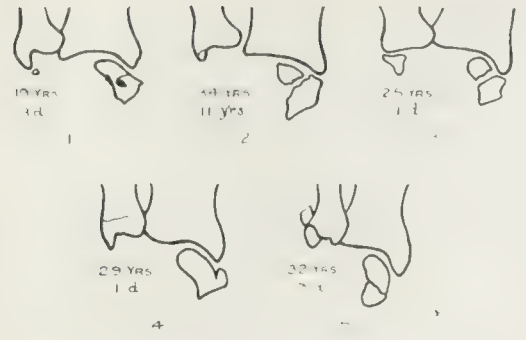

Diagram VII. Three combined naviculo-ulnar fractures (*2*, *3* and *5*) associated navicular fracture and "ulnare antebrachii" (*1*) and associated navicular fracture and (?) "triquetrum secundum" (*3*).

of the semilunar which was perpendicularly luxated forward, and the fracture of the scaphoid waist was accompanied by intrinsic and extrinsic synostosis.

In the last three cases (Diagram VIII, *1*, and Figs. 3, 4, and 5), the lesions are even more complex. The first case shows a dislocation forward of both scaphoid and semilunar. The scaphoid was the seat of a crack slightly above the waist which was confirmed at the operation. In Figure 4, is represented a case seen 33 months after resection of the semilunar and proximal scaphoid fragment which had been performed 3 months after a backfire. This roentgenogram shows a marked alteration in the carpus, but the range of movement was fair. In Figure 5, is shown the last case of this group. These lesions were due to a fall on the hand in extension. The semilunar is luxated forward and is the seat of marked calcareous atrophy. The ink lines shown in the roentgenograms were drawn after a careful stereoscopic search. The proximal scaphoid fragment is luxated backward. This was a case of divergent naviculolunar luxation. The ages of these individuals were between 23 and 43 years. Eight cases were of the right and 3 of the left hand.

4, b. Scaphoid and cuneiform. There were two cases as shown in Diagram IX. Both resulted from falls on the hand, and the lines of the cuneiform fracture are in one case, *1*, Diagram IX, an incomplete vertical crack and in the second, *2*, Diagram IX, a transverse complete fracture. In this case the distal navicular fragment was synostosed with the radius.

5, b. Scaphoid and trapezium. There was one single case of fracture of the navicular waist and compression fracture of the navicular tuberosity and trapezium. This was due to a fall on the palm of the hand in a girl aged 19 years.

6, b. Scaphoid and os magnum. There were four cases shown in Diagram X, *1* to *3*, and the last not included there, being like *3* as far as the os magnum is concerned, but slightly higher than the level of the navicular crack. The fracture represented in *1* was due to the passing of the wheel of a car over the wrist, and in that represented by *2* to a back-fire which produced a complete transverse crack of the os magnum neck. The other two were due to falls on the palm of the hand. This type of os magnum fracture and those described above (Diagram IV) are by far the commonest—Guermonprez, Moty, Robert. The vertical split appears to be of great rarity.

7, b. Scaphoid and unciform. There was one case due to a fall on the palm of the hand. The scaphoid fracture was comminuted at the waist and the unciform was cracked as in Diagram V, *1*.

8, b. Scaphoid, semilunar, and radius. There was one case due to a fall on the hand. The radial fracture resembled that seen in Diagram VI and the naviculolunar lesion was one of compression and comminution at the zones of contact between the bones.

9, b. Scaphoid, semilunar, and ulna. There were two cases (Diagram VIII, *2*, and Fig. 6, *16*). Both were due to falls on the palm. The former displays a divergent fracture-luxation of the semilunar and proximal scaphoid segment, and os magnum-unciform fusion. The latter is a case in which both the semilunar and the proximal navicular portion are reluxated forward. In both cases the ulna fracture is located at the styloid process.

10, b. Scaphoid, semilunar, and os magnum. There were two cases due to falls on the palm. In Diagram X, *5* is represented a fracture-compression at the scapholunar junction, a vertical crack on the radial surface of the

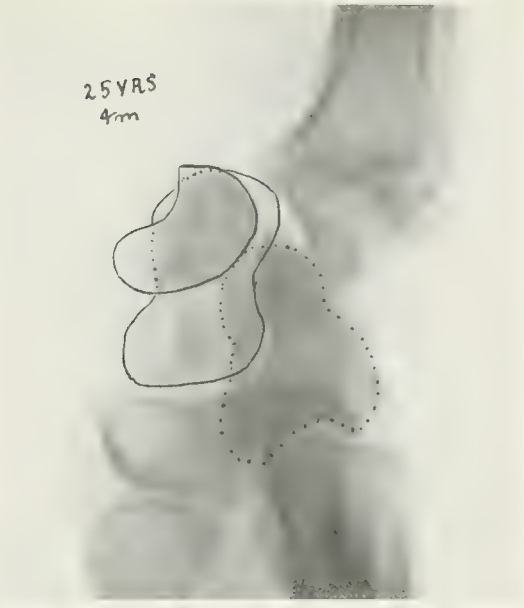

Fig. 3. Lateral view of same case represented in Diagram VIII, *1*.

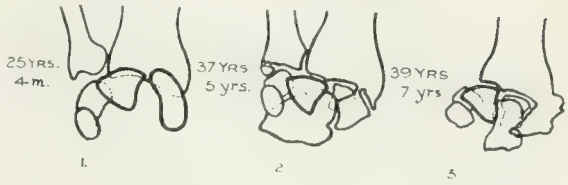

Diagram VIII. Three cases of semilunar displacement or backward dislocation of the os magnum. *1* represents an associated luxation forward of the scaphoid; *2*, an associated dislocation backward of the proximal scaphoid fragment, fracture of the ulnar styloid, and os magnum unciform fusion; and, *3*, an associated backward luxation of the proximal scaphoid portion, cuneiform fracture-indentation of the os magnum. In these last two cases there is extrinsic radial synostosis of the proximal navicular fragment. Note the triangular outline of the semilunar and the extent of its cuneiform superimposition.

semilunar and the os magnum showed a small oblique crack in its lower border. The second case is represented in Diagram VIII, *3*, and it shows a luxation forward of the semilunar, backward dislocation of the navicular proximal fragment, an os magnum crush at the point of contact with the navicular tuberosity, and a very marked scaphoradial synostosis of the distal segment. The semilunar was not in any of the cases of this series fractured in several places (Peste), or fractured transversely as in Hunt's case.

11, b. Scaphoid, semilunar, os magnum, and unciform. There was one case due to a fall on the palm, and seen 18 years after the accident (Fig. 7). There are very marked secondary changes in the radius, a luxation forward of the semilunar, a fracture and extrinsic radionavicular synostosis, and a crack through the unciform and os magnum where motion apparently took place.

12, b. Scaphoid, trapezoid, and os magnum. There was a case as shown in Diagram X, *4* and due to a fall.

13, b. Os magnum and trapezoid. There was one case, Diagram XI, and due to a fall on the palm of the hand.

14, b. Os magnum and unciform. There was one case seen 3 months after a fall on the palm of the right hand which showed impaction between the articular surfaces of both bones.

15, b. Os magnum and metacarpals. This was the case of a woman 28 years of age, who fell on the dorsum of the hand. It proved to be an incomplete crack of the os magnum as in Diagram IV, *1*, and an oblique fracture of the bases of the third and fourth metacarpals which ran downward and inward.

16, b. Trapezium and metacarpal. This was a fracture of the internal and inferior angle of the trapezium and a small crack at the outer border of the base of the first metacarpal. The fall took place on the thumb flexed on the palm of the hand.

17, b. Cuneiform, pisiform, unciform, and metacarpal. This was the case of a fall on the ulnar border of the wrist. There was a fracture of the cuneiform similar to that shown in Diagram IX, *1*, an oblique crack of the pisiform, a fracture of the ulnar border of the unciform running upward and outward and an oblique crack at the inner border of the base of the fifth metacarpal. The lateral roentgenogram revealed numerous fragments of bone at the level of the carpal damage.

18, b. Carpal fusion. This was the case of a very severe crushing injury penetrating to the carpus (Fig. 8). The wrist was ankylosed in a position of 15 degrees of palmar flexion. There was very marked metacarpophalangeal rigidity. Figure 9 is a roentgenogram of the

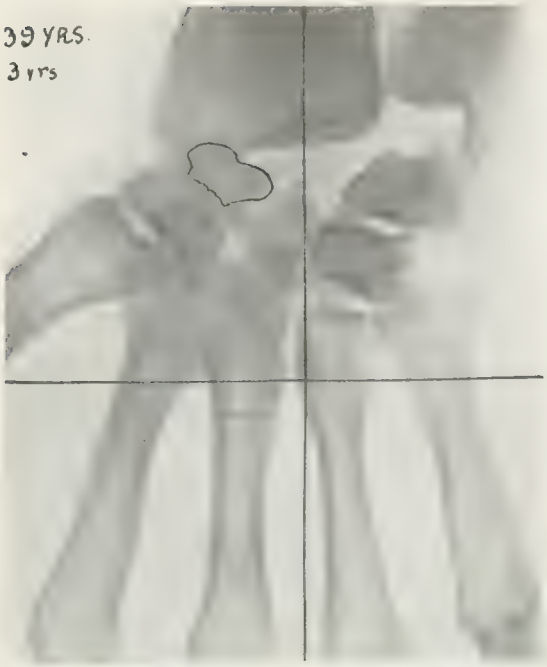

Fig. 4. Result of the resection of the semilunar and proximal navicular fragment 33 months previously. Note secondary changes in os magnum and radius.

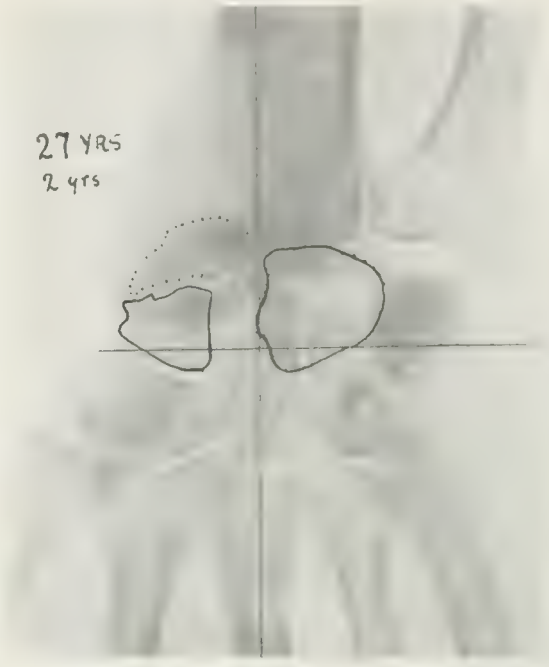

Fig. 5. Shows the after-result of combined semilunar os magnum luxation and posterior displacement of the proximal scaphoid segment, seen 2 years after the accident. The displaced semilunar is the seat of very marked calcareous atrophy. Note the extent of its radial-cuneiform-os magnum and unciform superimposition.

same wrist taken 30 days after the operation for "mobilization" and with the hand kept in extension to the end of a Thomas' arm splint. Figures 10 and 11 show the degree of motion obtained 3 months after operation.

An analysis of the *histories* given by the cases above referred to, shows that a fall on the hand is by far the commonest mechanism of fracture. The fall usually takes place as described by one of the cases (Diagram II, *39*) a doctor, as follows: "I was thrown from my motorcycle and landed on my hands, striking the kerb with the palmar aspect just below the wrist." I have examined the new pair of gloves he was wearing at the time, and by the erosion in the leather it can be said that the fall was on the hypothenar eminences with the hands adducted. In some cases it is the thenar eminence that strikes the ground. The fall on the dorsum of the hand occurs in a few cases, and in a fewer number still on the metacarpal heads with flexed thumb or fingers. The direct type of injury—fall of weights on the wrist, crushing injuries, kicks, and direct back-fires—are rarer. The indirect type of back-fire in abduction occurs more commonly than the direct. The *mechanisms of the injury* were distributed as follows:

	Cases
Fall on the hand	100
Fall of weight	14
Back-fires (indirect)	9
Total	123

After the accident has happened the patients usually notice in the case of *navicular injury or upper carpal syndrome* that "it is too painful to bring the thumb into action in any way." And a little time after that "the pain is severe, of a dull aching character, which makes one feel somewhat sick." The pain is to be felt "all round the wrist, and it appears to be impossible to find any position to lessen it. Sometimes such a position appears to be found, but it becomes intolerable after a while." The movements of

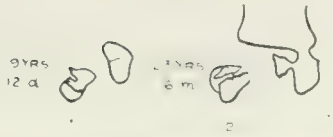

Diagram IX. Two associated naviculo-cuneiform fractures.

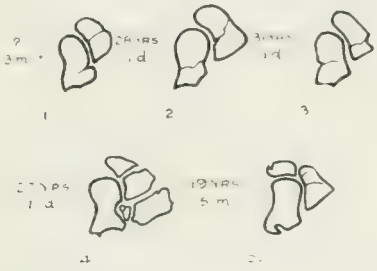

Diagram X. Three naviculo-os magnum associated fractures (*1* to *3*); a combined naviculo-trapezoid-os magnum fracture (*4*); and, a combined naviculo-lunar fracture-compression, and lunar and os magnum fracture (*5*). *2* demonstrates a complete fracture of the os magnum neck as well.

the pollex and the extension of the wrist are the most painful.

In the case of the *os magnum retrolunar luxation* or what might be called the *lower carpal syndrome* the main feature of the history is the rigidity and stiffness noted *ab initio* by the patients. The pain may be even more severe than in the case of the upper carpal syndrome, and that invariably means involvement—stretching or even rupture—of the median and more rarely the ulnar nerves.

In the *late cases*, those seen sometime after the injury, the histories vary somewhat (Marshall). A rather common feature of some of these cases is the complete oblivion of the trauma. And then they come up complaining of several degrees of disability: painful extension or flexion of the wrist after a certain point; the need of having "to let go" in some attitude of the hand performed hurriedly, which in some cases can be avoided whenever the patient's attention is concentrated on the movement; difficulty or inability in grasping objects, tools, sporting clubs, owing to pain, muscular weakness . . . ; some more or less marked degree of swelling, accompanied or not by pain; more or less marked degree of articular stiffness; nervous dystrophies of the

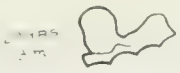

Diagram XI. A transverse associated fracture of the os magnum and trapezoid.

hand, etc. In some cases the history is definitely allied to the trauma that produced it.

It will be noticed after reviewing the above cases that the bones entering into the formation of the wrist were involved, as shown in table.

	Cases	Single Lesion Cases	Associated Lesions Cases
Radius	8	0	8
Ulna	7	0	7
Scaphoid	156	68	88
Semilunar	20	2	18
Cuneiform	3	0	3
Pisiform	1	0	1
Trapezium	2	0	2
Trapezoid	2	0	2
Os magnum	15	6	9
Uniform	8	4	4
Metacarpals	5	0	5

This shows the scaphoid to be the bone most commonly involved and the pisiform the rarest. The semilunar and os magnum are next in importance after the scaphoid. They are both intimately in correlation as will be shown later. The proximal scaphoid fragment was very markedly luxated forward in 4 cases, and backward in 3 cases. There were 8 cases of combined semilunar-os magnum luxation, and two of these cases showed a divergent type of naviculolunar displacement. The cases of rotation of the fragments *in situ* are not included among the above-named. The ulna was luxated backward in one case. It is worth mentioning that the dislocations met with in this series never attained the degree described by Couteaud, Nicotra, etc. It will be noticed that 35 per cent of the navicular and 90 per cent of the semilunar lesions were of the associated type. Fifty per cent of the semilunar lesions were due to the luxation backward of the os magnum.

DIAGNOSIS

The upper carpal syndrome corresponding to the navicular fractures and associated lesions gives rise to a swelling over the scaphoid area; lower radial or wristlet-like pain on attempting to move the pollex or abducting

Fig. 6. An old associated naviculolunar displacement forward, and ulnar styloid fracture Note the marked secondary carpal changes and the calcareous atrophy of the luxated bones. This is a case of 6 years' duration.

the wrist; fork-like deformity of the wrist if there is a radial lesion with displacement and, alteration in the alignment of the styloid line should the radius, ulna, or both be involved. Ecchymosis is rare in the single scaphoid injury and usually suggests an associated lesion.

The lower carpal syndrome, corresponding to the os magnum-semilunar associated displacement, is characterized by an increase in the anteroposterior diameter of the wrist; palmar swelling below the center of the styloid line; depression at the knuckle line of the head of the third metacarpal; low type of fork-like deformity of the wrist; and, stiffness of the fingers which are usually held in slight extension.

The Vaughan percussion test described by Murphy shows, in the early stages of these conditions, the maximum of tenderness to be at the third metacarpal head in the lower carpal, and at the second metacarpal head in the upper carpal syndrome.

Crepitation is very seldom felt in the single injuries, and its presence in my experience represents an associated lesion of the wrist.

I shall refer very briefly to some points on the morphology, physiopathology and radiology of the carpus as the best means of understanding the facts given above and their clinical interpretation.

MORPHOLOGY

An examination of the skeletons of certain vertebrata of aquatic habits — crocodiles, phoca, whales — reveals the ulna to have marked carpal connections, and the two carpal ranges to be formed by arthrodia of uneven surface which come, in the boundary zone between the proximal and distal carpal series, to a straight line.

In the heavy mammals—rhinoceros, elephant—the ulnar contact with the carpus is very marked; the ulna appears to be the dominating forearm bone, the radius twists in front of it, the deambulation is in pronation; and again the carpal bones are regular and evenly distributed. The pisiform is in these animals a well formed bone.

In the bovidæ and equidæ the ulnar carpal connection is rudimentary, the ulna is an elbow structure; the carpal anatomy is simple; the articulations are of the arthrodial type, and the line between the proximal and distal carpal ranges is linear; and the pisiform is a well-formed structure.

If the smaller monkeys—semnopithecus entellus—are analyzed it will be seen that the pisiform appears like the posterior tuberosity of the os calcis in the foot. At first sight the hand looks like a foot. In the tiger, hyena, bear, dog, the pisiform assumes a position and importance as shown in the monkey entellus, for instance.

The examination of a higher monkey skeleton, troglodytes gorilla, demonstrates the ulnar carpal connections to be very faint, a marked mesial forearm twist, the great size of the scaphoid tuberosity and pisiform, ridges of the trapezium and uncus of the unciform, and an already well-established connection between the os magnum head and the proximal carpal range. Condylarthrosis appears to be the type of articulation between some of the carpal bones. The hand is an organ of progression as well as of prehension. The ligaments of these articulations resemble very closely the human.

In some of these animals, sea-lion, tiger, cat, dog, etc., the scaphoid is fused with the

semilunar, and in some cases other intercarpal fusions or duplications are to be noticed.

In man the hand is no longer an organ of locomotion being only a prehensile instrument that is anatomically represented in the carpus by the following features. The os magnum head forms a center of marvelous anatomical contact; it is the pivot of the system. There is a reciprocal fitting in of the os magnum head into the proximal, and of the scaphoid foot with the distal carpal range. The anatomical fusions are rare, i.e., the scaphoid-centrale. The pisiform almost disappears since it is the representative in the carpus of manual deambulation, it is the heel of the hand of non-aquatic vertebrata and a regressive structure in man. All the ridges and tuberosities, so well marked in the troglodytes, are ill developed because man has no longer to climb trees for his existence. The ulna-cuneiform contact is very faint and through the triangular ligament which is well developed in monkeys. In fact the ulna is an elbow structure. The intercarpal articulations attain the highest degree of mechanical differentiation: condylarthrosis, an idea of slight enarthrosis, and a very marked inter relation between the proximal and distal carpal ranges, leading to delicacy and firmness of motion, is to be seen in the arthrology of the human carpus. These plastic facts are in accordance with the high functional value of the hand of man and with the difficulty in explaining the physiopathology of the wrist, and the synergy of the movements performed at the same time by the several anatomical elements of the carpus.

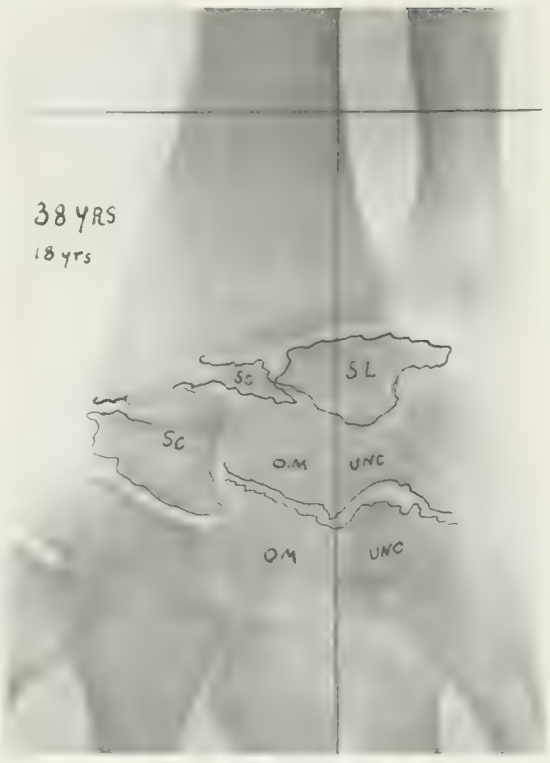

Fig. 7. Shows an old 18 years associated naviculo-lunar displacement forward, and os magnum unciform transversal crack. Note the double scaphoid radial synostosis and degree of inflammatory fusion of the upper carpal range.

PHYSIOPATHOLOGY

The movements of the carpal bones can be followed by reading Diagram XII, which represents 3 lateral roentgenograms of the wrist taken in *full extension* (*1*), *extension* (*2*), and *full flexion* (*3*).

In hyperextension, *1*, the scaphoid is slightly inclined backward and upward, the semilunar articulates with the center of the radial articular surface by its postero-superior surface, the os magnum is inclined upward and its head articulates with the antero-inferior part of the semilunar.

In extension, *2*, the scaphoid assumes a more inclined position backward and upward, the semilunar is horizontally placed, and the os magnum body has advanced forward.

In hyperflexion, *3*, the scaphoid head is looking backward, its foot is almost touching the radial brim; the semilunar follows the scaphoid head and by the middle of its upper surface articulates with the posterior part of the radial surface; the os magnum head now articulates more fully with the semilunar, and its body has advanced forward. The trapezium and trapezoid follow the navicular foot, the unciform the os magnum base, and the cuneiform the semilunar. In fact, Destot stated that the semilunar and cuneiform act as a meniscus to the radius and distal carpal range.

If pressure is now exerted in the palm of the hand, thenar, or hypothenar eminences,

Fig. 8. A case of carpal traumatic fusion.

Fig. 9. Same as represented in Figure 8 one month after the operation of "mobilization." The hand is in an extension splint.

and heads of the metacarpals and back of the hand in the three positions chosen and roentgenographs are taken as before, it will be seen that the scaphoid is the bone which will behave differently. In fact, in position of hyperextension, *1*, if the thenar eminence is forcibly pressed on and consequently the navicular tuberosity, the pressure transmitted along the body of the bone will force the scaphoid head backward which will assume a position like that seen in Diagram XII, *2*. This is, as it were, an anticipation of the attitude of the bone. The other bones will only show a more accentuated attitude, they all become more clearly horizontal, vertical, etc. In position of hyperflexion, *3*, it will be seen, however, that the os magnum head articulates with the anterior horn of the semilunar and becomes even obliquely placed backward. A marked contraction of the flexor muscles of the wrist will bring the pisiform well away from the cuneiform. This shows how the pisiform is emancipated from the human carpus in so far as the refined movements are concerned.

The physiology of the movements of abduction and adduction of the wrist is too well known to need repetition (Bryce, Destot, Lesshaft). Again the navicular and the semilunar are the bones that show a greater degree of excursion on the radius.

The dissection of the carpus will explain the facility of movement that some of these bones have exhibited in the directions above referred to. It will be seen that there is a fascial layer all round the wrist which hides the capsules of the joints beneath. The removal of these capsules shows the os magnum head to be the point that displays the greater freedom of ligaments. The os magnum base is, by means of bands filling in the interosseous intervals, well attached to the bones surrounding it. From the anterior horn of the semilunar radiates upward and outward a triangular band attached to the outer third of the radial brim. If the wrist is then flexed there will be seen at the inner end of the radial articular edge an identical type of band radiating toward the naviculolunar junction, and if flexion is forced further the upper pole of the semilunar is found bound up to a fascial band which attaches it to the cuneiform and triangular ligament. The examination of

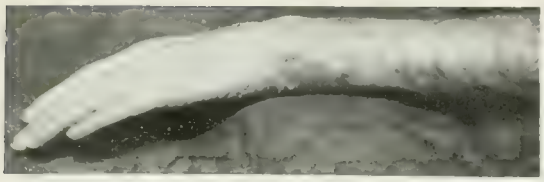

Fig. 10. Same case as in Figures 8 and 9, 3 months after the operation.

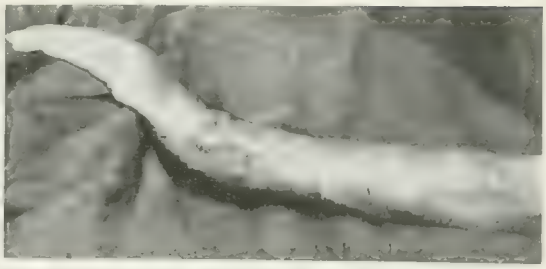

Fig. 11. Same case as in the three preceding figures, 3 months after the operation, displaying the extent of motion obtained.

one's hand demonstrates the scaphoid under the radial styloid when the wrist is adducted, and the os magnum head can be seen and felt as a definite lump at the back of the hyperextended wrist. It can, therefore, be said that each carpal bone has a definite and independent function to perform throughout the various stages of movement of the wrist. Some of these anatomophysiological points have been brought forward in the well-known works of Destot and his school, Delbet, Jeanne and Mouchet, Tanton, etc.

The scaphoid fracture occurs in the case of hyperextended wrist if the hand is abducted (Destot, Codman and Chase, Gabaglio, McCarty, Pilcher, Schulz, Skillern and Speese); and if the hand is adducted, as Destot claims, the scaphoid, the radial styloid or a posterior marginal fracture (Letenneur) may be the consequence. An anterior marginal fracture (Barton), a fracture of the scaphoid or a fracture compression of the naviculolunar contact or of the semilunar itself associated or not with backward displacement of the os magnum may result from a fall on the palm of the hand. This has been proved by means of experimental work and by the evidence of clinical data. The marginal fractures are the rarest in our experience. The abduction compression fractures of the naviculoradial junction (Diagram VI, *4* and *5*) have been described by Vialle, Caccia, and Pilcher in great detail. These fractures are usually the result of an indirect back-fire. The ulna appears to be fractured when there is a marked abduction trauma which, by a mechanism identical with that producing a Pott's fracture, explains the scaphoid fracture and the ulnar styloid injury. If the force is great the triangular ligament can be ruptured and the ulnar end may be luxated backward or forward, if a movement of torsion is present in conjunction with the trauma (Diagram VII, *5*). The combined naviculolunar injuries may be explained by a similar conception. In some rarer abduction carpal fractures the foot of the navicular appears to press on the os magnum waist and produce either on its outer border, inner border, or by propagation through to the unciform some of the fractures described above (Diagram IV, V, and VIII). The anatomical distribution of the carpal interosseous ligaments appears to explain satisfactorily the distribution of these fractures. The displacement of the scaphoid fragments is understood by means of the movements it displays and by the distribution of its ligaments. For instance, a sudden force

Diagram XII. The relative positions of the scaphoid, semilunar, and os magnum assumed by these bones in the hyperextension (*1*), extension (*2*), and hyperflexion (*3*) of the wrist.

Fig. 12. Shows the plaster splint applied in a case of navicular fracture. Note the fixation of the thumb.

acting on the thenar eminence will, by pressing on the navicular foot, luxate its head backward and produce a fracture of the scaphoid (Auvray, Ely, Russ, Stimson). The navicular fractures due to direct injuries usually occur as the result of circumduction movement produced by the trauma. The fracture happens before the scaphoid assumes an anteroposterior direction which is seen at the last stage of wrist hyperflexion (Diagram XII, *3*). A sudden hyperextension of the wrist due to back-fire, fall on the palmar surface of the metacarpal heads originates some of these fractures which are better understood by the position of the navicular (Diagram XII, *1*) vertically placed against the radial surface. The types of combined naviculolunar displacement are explained by Diagram XII, *1* and *2*. The navicular head will be forced backward through pressure on the tuberosity, the head of the os magnum being displaced in the same direction. The semilunar then slips in an opposite direction forward and a divergent type of dislocation results.

The semilunar and os magnum (Diagram XII) are intimately associated (Blake, Codman and Chase, Groves, Hessert, Hildebrandt, Jeanne and Mouchet, Lesser, Lilienfeld, Murphy). Some of the debated points have been settled by Delbet "that the luxation backward of the os magnum brings back all the carpus with the exception of half of the scaphoid, and sometimes the cuneiform, after rotation of the semilunar by the os magnum." The trauma may occur with the wrist in any of the positions above named. The integrity of the radiolunar ligaments will prevent a more advanced degree of the lunar luxation, as the posterior fascial capsule will avoid a higher backward displacement of the head of the os magnum. The incomplete rupture of the anterior radiolunar ligament explains the anterior horn as the semilunar acts as the center of fixation for its dislocations. The os magnum head slips backward under the demilunar facet (Diagram XII, *3*), and actually presses on the posterior horn of the semilunar when returning to the former position. Hence the designation of the semilunar luxation as backward dislocation of the os magnum or retrolunar displacement. The extent of the lateral deviation of the wrist associated with a variable degree of flexion and extension renders the possibilities of the mechanism of these fractures and fracture-dislocations even more complex. A systematization of these injuries is described in the work of Jeanne and Mouchet. The varied degrees of semilunar displacement is well brought forward in Murphy's lecture. In none of the cases of the series was I able to find a case similar to Bolton's radiolunar lesion.

CARPAL RADIOLOGY

The way in which the carpus has been centered has a great bearing on the radiological findings. To this effect I have examined a series of plates of the extended wrist centered as follows (a) on the lower third of the forearm; (b) on the wrist itself; (c) on the metacarpal region.

In position *a* the radio-ulnar outline is linear; the scaphoid appears lengthened and its foot overlaps part of the three outer bones of the distal carpal range; the contiguous surfaces of the semilunar and cuneiform are superimposed; the carpometacarpal line appears as if fused; and there is distal digression of the pisiform and shadow of the uncus.

In position *b* the radio-ulnar outline is double; the scaphoid is shorter and less overlapped by the shadows of its neighbors; the luno-cuneiform junction is still indistinct; the separation between the proximal and distal carpal ranges is more distinct than the carpometacarpal line; and there is less downward digression of the pisiform and uncus.

In position *c* the radio-ulnar outline is linear; the scaphoid appears shortened and the outline of the tuberosity projected on the body may resemble a crack; the articular carpal separation is clear; the semilunar is slightly superimposed on the radius, and there is a clear view of its posterior horn; the carpo-metacarpal line may appear double in places through superimposition of images and give the appearance of fracture; and there is proximal digression of the pisiform and shadow of the uncus. It appears, therefore, that the upper metacarpal exposure brings into view the clearest detail and individualization of the proximal carpal range; and the

central or carpal exposure the best view of the distal carpal range. The pisiform and the shadow of the uncus are the best points of reference for establishing how the carpal views have been taken. These facts are even more clear in stereoscopic roentgenograms which should always be taken. It is hardly necessary to insist on the importance of the lateral roentgenogram, a careful reading of which gives the exact displacement and degree of comminution of the fragments, which appear in some cases as a bony dust.

The control view of the opposite carpus, taken in another plate, excludes some congenital conditions which can be unilateral as I have verified. Among the commonest are to be mentioned the "epilunatum," "pretrapezium," "ulnare antebrachii," "os triquetrum secundum" which appear in 1 per cent of cases. The navicular is the carpal bone more commonly congenitally divided in 2 pieces (1 per cent), 3 or 4 fragments, although Dwight's view that a fractured scaphoid is only a separation of the pieces of a "naviculare bi- or tripartitum," appears to be not the case. The degree of comminution, the variety and levels of the lines of fracture, the features of the edges, the gap between the fragments, and the appearance of the navicular surfaces as shown after removal (Todd) exclude that theory.

The anteroposterior image of a displaced semilunar is not only conical, as Murphy pointed out, but the degree of radial-cuneiform-os magnum-unciform superimposition is very marked (Diagram VIII, *1* to *3*, and Fig. 5) in any of the 3 above mentioned positions of exposure. The shapes of the scaphoid varying from a reniform appearance to a more or less cylindric figure (Gruber) impart to the radiological appearance of the bone some differences of outline.

TREATMENT

The upper carpal lesions usually require rest and the lower ones early movement. If the case is seen early any dislocation should be reduced preferably under a general anæsthetic. The wrist should be, in the case of scaphoid fracture, mantained for 4 weeks as in Figure 12. The plaster is changed twice because it gets loose and to allow for slightly altering the degree of wrist hyperextension. The pollex is included since it forms the continuation of the naviculo-trapezium pillar, whereby comfort is given to the patient who stops "feeling pain" and only "feeling the wrist." In old cases forcible wrenching, as advised by Sir Robert Jones, and in some patients where there is pain or radio-navicular synostosis, resection of the scaphoid sometimes relieves the pain and improves the degree of mobility of the wrist. The wrist is maintained, for sometime, in a well-fitting leather bracelet which appears to avoid the development or the aggravation of secondary tenosynovitis. The tenosynovitis when present is improved sometimes, by means of thermotherapy, heliotherapy, and electrotherapy. Early movements should be advised after the reduction of the os magnum retrolunar luxation.

If the fragments cannot be replaced they should be removed. A palmar incision is preferable for the semilunar and a lateral one for the scaphoid. Early movements should be advised. Figure 3 shows a case of semilunar and proximal scaphoid excision 4 months after the trauma. The result was fair. Figure 4 shows a case seen 33 months after an identical operation performed 3 months after the injury. The movements were painful and there was marked swelling at the wrist. An identical operation performed much later (Fig. 6) slightly improved motion and pain. All these facts favor an early reduction or removal of the non-reducible fragments.

The "mobilization" of the wrist was performed in one case (Figs. 8 to 11). Fascia lata as advised by Putti was used. The hand was kept in the intervals of the massage and movements of fingers and wrist, in an extension to a Thomas' splint for one month, and in a "cock-up" splint for another month. The works of the pioneers in this field are well-condensed in Serra's monograph. The future of these operations is great and the results obtained fully justify their repetition.

PROGNOSIS

Thirty per cent of the cases of the series had met with the carpal injury 4 months to 18 years previously. Diagram III and Figures

5, 6, 7 and 8 are good examples of late cases. It is remarkable how it is possible for these patients to put up with such disabilities which, slight at first, will later lead to a very marked degree of articular invalidity. Usually the upper carpal type of lesion, is of worse omen than the lower. In fact the navicular fracture, on account of being more frequently overlooked, is the cause of great impairment of the functional value of the wrist. The fragments, in our experience, seldom unite, as Downes maintained, in spite of immediate prolonged immobilization for 3 or 4 weeks. However any of the above conditions if seen early and early treated usually leads to no disability at all.

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MODERN TREATMENT OF CANCER OF THE LIP[1]

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EVER since radiation was first recognized as a possible curative agent against cancer, the surgeon has referred the inoperable and most advanced cases to the radiologist for treatment. Its use was at first regarded as an experimental measure, and, as we must all confess, also a convenience at times. The radiologist accepted such cases and proceeded to do what he could for them. At first the outlook was practically a hopeless one, but even though failure seemed the rule and a result in any way favorable the great exception, and criticism re-echoed the word "failure," the cases continued to be referred, and something had to be done for them. The radiologist did not become discouraged because he realized the possibilities in development of an apparently limitless field for research.

As a result, this branch of medicine has developed more rapidly than any other during the past 20 years. This is due in a large measure to the fact that radioactivity and the production of X-rays have been subjects of unusual interest to the physicist, in whose investigations the radiologist has recognized the solution of many of his problems. Naturally the bonds of mutual interest between the two investigators have grown stronger with years of co-operation. The highly competitive business proposition involved in the manufacture of apparatus has been of great assistance. The radiologist is calling upon the pathologist more and more for assistance that will lead to a better understanding of malignancy and the effects produced by radiation. Much knowledge is yet to be gained from investigations by the biologist and therein seems to lie the greatest field for activity in the near future. Co-operation with the surgeon will continue to be sought.

It must be apparent, therefore, that the radiologist is endeavoring by every possible manner of investigation to contrive means of accomplishing what surgery has failed to do. That he has been successful in some measure must be conceded. There is probably more that can yet be accomplished. A large part of the imposed task of successfully treating advanced malignancy must be acknowledged as impossible. It is sometimes difficult to draw the line sharply between the rarely possible and the impossible type of case, but such a line is important in order that the use of radiation treatment may not fall into disrepute in the lay mind. No doubt much of the innate fear of the knife has originated from the attempt of surgery in the past to try what it could not hope to accomplish in the cure of malignancy.

The radiologist probably sees more of the worst wrecks wrought by cancer than anyone else, and when he realizes that each case began in a small way at a period when the lesion, in most instances, could have been readily cured by surgery or by the proper use of non-surgical measures, he is appalled by the now existing general lack of recognition of cancer at its early stages, the failure to treat such cases at the most opportune time, and the apparent disregard of preventive measures that will tend to eliminate recognized exciting causes of cancer in such localities as the lip and buccal cavity. It still seems that the education of the lay mind and the physician to the realization of the importance of recognizing cause and early effect is woefully lacking. How often do we still see the jagged tooth digging into the cancerous area in the tongue or cheek, and even worse, the well-developed epitheliomatous ulcer of the cheek that has been repeatedly stimulated by applications of nitrate of silver.

Radiology has taken up no fight against surgery, nor does it regard surgery in any way as a competitive measure. It has been forced to develop a technique that will in a measure deal successfully with some of the cases in which surgery is impossible, and in doing this, it expects some recognition. Naturally it can, as a rule, deal more success-

[1] Read before the Clinical Congress of American College of Surgeons, Philadelphia, October 20, 1921

fully with border-line cases than with the more hopeless ones. Having gone so far, we, as radiologists, feel that if we can produce proof of just as successful results as surgery in what have been generally recognized as operable cases in the past, it is our right to treat such cases also. Naturally we shall aim to produce better results than surgery whenever possible, but, above all, the best interests of the patients are always to be uppermost in our minds. Cooperation between the surgeon and radiologist is frequently of paramount importance. Radiology may be employed as an ante-operative procedure in conjunction with surgery, or as a postoperative measure. It is a well-recognized fact that radiation cannot do well in what surgery has tried to do and failed. The recurrent case after operation does not respond as well as the primary case because we have to deal with anatomical, physical, and biological factors that are quite different.

There are three recognized agencies for dealing with cancer at the present time: preventive measures, surgical procedures, and non-surgical methods. Preventive measures are more widely applicable about the mouth than any other locality. Proper attention to the teeth can unquestionably prevent many cases of cancer or precancerous conditions. The regulation of the use of tobacco may help in cases showing a tendency to leucoplakia. When syphilis seems to be a possible factor, antisyphilitic treatment should be pushed energetically, but too much valuable time should not be expended solely on such a measure when the lesion does not appear to respond. Leucoplakia should always be carefully watched and treated if necessary, and cracks and fissures on the lips should not be allowed to persist.

It is not our purpose to discuss surgical measures except from the standpoint of cooperation with non-surgical methods. The non-surgical methods which are now generally recognized as applicable in the treatment of lip and mouth cancer and its metastasis are the use of radium, the X-rays and electrothermic coagulation, or possibly the actual cautery. In many instances all of these agents must be combined, and frequently with surgery. In comparatively few instances is any one of them employed alone.

Cancers involving the regions designated may be roughly grouped into lesions involving the lower lip and corner of the mouth, the tongue, primary lesions in the floor of the mouth, the tonsil, and in the mucous membrane covering the cheeks, the alveolar processes, the palate and pillars. The disease in each of these anatomical structures requires separate consideration. Mainly for obvious anatomic reasons the upper lip is not included except when the disease involves the portion near the corner of the mouth. From the standpoint of a radiologist, the essential purpose of this paper must of necessity be the presentation of the present status of non-surgical methods of treatment.

THE LOWER LIP

The radiologist is probably not so much concerned as he should be in distinguishing between epidermoid and basal cell cancer of the lip. He realizes what the worst outcome may be and treats all cases with that idea in mind. He sees too often the results of direct surgical trauma to cancerous tissue and is loath to satisfy his curiosity by pathological proof of the cellular characteristics of a lesion unless certain that the removal of a specimen is absolutely safe.

Theoretically, lip cancer should be readily cured by surgery because both the primary and metastatic lesions are easily accessible, but this is not the result practically, mainly because surgery does not always remove all the cancer and a large number of cases are not seen sufficiently early. Surgical results would be ideal if some means of education could inculcate in the mind of every individual that every ulcer, fissure, or keratosis of the lip persisting for several weeks, especially if showing induration, and if syphilis be excluded, is either cancerous or potentially cancerous, and that such an area should be removed. The vast majority of lip cancers have, unfortunately, gone beyond this stage when first seen. The general run of cases as we see them may be divided into three groups, from the standpoint of methods of

treatment, prognosis, and statistics, as follows: primary lesions without any evidence of metastasis; cases presenting small palpable nodes in the submental or submaxillary triangles; and those with advanced primary lesion and large nodes in these areas or in other gland groups. The greatest danger from cancer of the lower lip is metastasis, which, if it has occurred, increases the death rate very considerably. In view of the frequency of metastasis every one who treats such cases by any method should have an intimate knowledge of the lymphatic drainage from the lip. Lymph vessels pass directly downward from the central portion to the glands in the submental triangle, and from the lateral portions to glands in the submaxillary triangles. The submaxillary salivary glands are well surrounded by lymphatics. If there is blockage in the lymphatics of one side from cancer or some inflammatory process, the free anastomosis with the opposite side readily permits metastasis to pass from one side to the other. After involvement of these groups of lymphatics, metastasis may proceed to others in the neck.

In the first group of cases, without palpable nodes in the neck, the results of surgery are good. Metastasis without palpable evidence is likely to be present in a certain percentage of these cases, however, and surgery alone cannot be complete without including the removal of all glands in the submental and submaxillary triangles. Broders[1] in 1920 presented statistics on 449 cases operated upon at the Mayo Clinic and in which lymph nodes were removed, and metastasis was found in 23.38 per cent. At best, the results of surgery are little more than 90 per cent of cures after 5 years. Sistrunk[2] in a recent communication presented statistics of cases of cancer of the lower lip operated upon at the Mayo Clinic during 1912, 1913, 1914. Of 93 complete cases in which the primary lesion was excised and glands in the triangles removed and found not involved, 90.3 per cent were living 5 to 8 years after operation. In eleven of these local recurrences were subsequently removed and there were three recurrences in neck glands.

The striking feature in these and many other statistics is the frequency of local recurrence, which indicates an incomplete removal of the primary lesion, leaving *in situ* cancer cells which have ample time to cause metastasis while the recurrence is developing to discoverable proportions. Obviously the results should be better, and surgery alone cannot be regarded as a complete method of treatment in view of our present knowledge of the effects of radiation. Many surgeons are satisfied to employ it as a postoperative measure. The wisdom of this is not borne out either by results or by scientific knowledge of the effects of radiation. It is our firm belief that every case should have at least a preliminary application of radiation before any attempt at removal of the primary lesion or lymph glands is attempted. We have not advocated non-surgical measures alone until a technique was developed which we believed was safe and certain of results. Too few cases have passed the five year period to make our statistics of value, but we are well satisfied so far with the results we have obtained.

Our technique comprises a preliminary radiation of the area of the primary lesion and well beyond all apparent evidences of involvement by radium. Cross firing is practiced as far as is possible, and we aim to produce a severe reaction. At the same time the region of lymphatic drainage is well radiated by radium, across the face from the level of the posterior aspect of one submaxillary salivary gland to the same point on the opposite side. A full dose of X-rays is then given over each side of the neck, and as the submental and submaxillary triangles are not apt to receive their full share of the dosage because of the protection of the mandible, these areas are given an additional dose of radium. This additional dose of radium produces a severe but not dangerous reaction. If the case is being thus prepared for the surgeon, we advocate waiting for the reaction to have reached its

[1] Broders. Squamous-cell epithelioma of the lip. J. Am. M. Ass., lxxiv, 956.

[2] Sistrunk, W. E. The results of surgical treatment of epithelioma of the lip. Ann. Surg., 1921, May, p. 521.

maximum and to subside slightly before operation, in order that the maximum effect upon the lymphatic channels as well as cancer cells may be brought about. If the case does not come from the surgeon, we proceed immediately to destroy the primary lesion by electrothermic coagulation, for two reasons: to obtain the added advantage of heat and to relieve the patient of the discomfort resulting from the severe radiation of the primary lesion. When a large mass of tissue is thus removed, there is some danger from secondary hemorrhage when the slough separates, and the patient is instructed how to stop the bleeding by pressure. Patients suffer little or no pain and there is only the annoyance from the sloughing process. Healing is complete in 2 weeks to a month. Usually there is insufficient deformity to require subsequent plastic surgery. As this procedure does not entail possible surgical trauma to cancerous tissue we do not fear the possibility of metastasis appearing later. The radiation of the neck is repeated once or twice at subsequent periods.

In dealing with cases belonging to the second group, we have practically discontinued giving postoperative radiation, unless it is employed as an anteoperative measure as well as the results do not warrant its use. Cancer tissue once directly traumatized by surgery without a complete removal and without previous radiation does not respond well to any form of treatment, and all too frequently upon the radiologist is laid the blame for inefficacy of radiation. If we are expected to treat cases at all, we should surely be accorded the privilege of directing that treatment along such lines as our experience shows to be the most effectual. The technique we now employ in cases belonging to the second group deals with the primary lesion, lymph-channel areas, and glandular regions in exactly the same way as in the first group, with destruction of the primary lesion by electrothermic coagulation. If the enlarged glands do not subside or do not diminish with reasonable rapidity, we may either try radium implantation or refer the case for block dissection, in which case we may regard the treatment already given as an anteoperative procedure. If the case is referred to us by a surgeon, the anteoperative treatment is given in the same manner as for group one cases, and the case is then referred back for excision and block dissection as soon as the reaction has subsided somewhat. It is then referred to us subsequently for postoperative treatment.

In this connection we are quite in accord with the procedure advocated by Quick[1] of embedding emanation tubes in the operative wound at all suspicious areas, and especially where lymph channels have been cut or cancer tissue has inadvertantly or of necessity been cut into and not removed in entirety. The resulting slow radiation and intense local but not far reaching reaction from β-radiation must certainly be efficacious, and entails no danger to the flap if the emanation seeds are well covered. One must use care in giving postoperative radiation following this procedure. We have not had the opportunity of following this technique because of the lack of an emanation plant at our disposal. The frequently flaunted objection of anteoperative radiation making the operation more difficult seems to be without good foundation, according to the statements of those who employ both radiation and surgery, especially if the operation is not performed at the time of the reaction.

We do not wish to go on record for the origin of a broad statement to the effect that cases of cancer of the lower lip, without metastasis or with early metastasis can be handled satisfactorily by non-surgical methods, for the reason that such a broad statement is subject to too much latitude in its interpretation. We do believe, however, that such cases can be handled in a perfectly satisfactory manner by non-surgical methods alone or in conjunction with surgery, but we absolutely insist that the technique carried out must be one similar to the one we have advocated, and that each procedure must be rigidly carried out to the most minute detail.

Cases belonging to the third group, with advanced primary lesion and extensive gland-

[1] Quick, Douglas. The conservative treatment of cervical lymphatics in intra-oral carcinoma. J. Am. M. Ass., 1921, Aug. 6.

ular metastases comprise an unfortunate class of mortals whom no one cares to handle. They usually fall to the lot of the radiologist to treat. The choice between surgeon and radiologist is practically one between two evils. Surgery cannot help, and usually makes matters worse. Radiation usually can do no better but is preferable. Implantation of radium into glandular metastases that have usually infiltrated through gland capsules is practically an imperative part of the procedure of radiation.

RADIUM TREATMENT OF MYOMA OF THE UTERUS AND MYOPATHIC BLEEDING

Final Results in One Hundred Eighty-Three Cases[1]

By C. JEFF MILLER, M.D., F.A.C.S., New Orleans

NO abdominal operation has reached a higher degree of technical perfection or given more satisfactory postoperative results than hysterectomy as usually performed for myoma of the uterus. It is generally conceded that the results, both primary and secondary, hardly permit of improvement. For these reasons it is difficult to convince the surgeon that any other method of dealing with myoma of the uterus and and hæmorrhage of myopathic origin can compete with the already standardized surgical procedures. Any other method of treatment must present properties rarely possessed by a therapeutic agent, and the results obtained by such a remedial agent must show that the relief is permanent, and that its use is safer than operation and gives a higher percentage of preservation of physiological function than an operation performed by a skillful surgeon.

That we possess in radium such a therapeutic agent, and that it will eventually supplant surgery in a large percentage of cases now treated by hysterectomy, I propose to prove by submitting the final results obtained in 183 cases treated with radium and observed over a period of 7 years. Between May, 1914, and July, 1921, 230 cases were treated by radiation, but satisfactory follow-up records are available in only 183 cases. It is useless to dwell upon the effects of radium, or the primary clinical results, since these phases of the subject are already definitely established, and about them there is little doubt. These records are of value chiefly because of the time that has elapsed since the treatment was instituted.

Since it may be inferred that I am overenthusiastic in regard to the use of radium, I would make this point clear in the beginning by stating that during the same period of time which this report covers nearly an equal number of cases have been treated surgically. Thus it can be clearly shown that I appreciate the limitations of radiation, and am by no means insistent that it can supplant surgery in all cases of myoma of the uterus or essential hæmorrhage. The age of the patient, the type and social situation, as well as the size of the tumor, the condition of the appendages, the evidence of previous infection, and the general condition of the patient, are all factors to be carefully weighed in determining the most satisfactory method of treatment.

Surgery is unquestionably the procedure of choice in young women who present definite growths causing excessive bleeding, submucous growths, or cases in which suspicion exists of malignancy of the fundus of the uterus. In these types of cases conservative surgery is decidedly less radical; this is a point that cannot be too strongly emphasized. In order to induce shrinkage or disappearance of a myoma, it is necessary to produce at least a temporary cessation of menstruation, and the dosage of radiation has not yet been so

[1] Read at Southern Surgical Association, Pinehurst, North Carolina, December, 1921.

controlled that a temporary suppression can be foretold with the degree of accuracy necessary for justifying its use when conservation of function is of primary importance. Therefore, in young women, when definite single tumors are present, the patient should be persuaded that operation offers a chance for myomectomy, with preservation of the physiological functions. In small multiple growths, when it can be definitely established beforehand that hysterectomy is necessary, radium should be adopted as the method of choice.

The most striking feature revealed in a review of both series of cases, those treated by radium and those treated by surgical intervention, is the increasing percentage of myomectomies performed, where formerly hysterectomy would have been done. The prevalent idea that myomectomy is attended with a high mortality and that second operations are necessary in too large a percentage of cases to warrant conservatism is not borne out by the results obtained by competent surgeons. The decision to resort to myomectomy in many cases which would have been subjects for hysterectomy formerly was prompted by the assurance that if myomectomy failed to control the hæmorrhage or check the menstrual disorders, radium would complete the cure without further surgical interference. With such assurance, the scope of conservative surgery has been materially widened, a larger number permanently relieved, and the percentage of subsequent pregnancies has further justified the decision.

Large myomata should be treated by myomectomy or hysterectomy. Unless some contra-indication to operation exists, there is no valid reason for the use of radium in large tumors. Massive growths too often present serious complications such as adhesions, salpingitis, degenerative changes, and pressure symptoms, to prompt the surgeon to depend upon radiation as the method of election.

Radiation has, however, a distinctive application in this group in that it will promptly control the hæmorrhage until such time as the consequent improvement in the patient's general condition will render her a safe operative risk. Radium is a valuable adjunct to surgery in this group, but it should seldom be the elective treatment in myomata larger than a three and a half months pregnant uterus. Upon this point the majority of observers generally agree, large growths only partially shrink, and the period of treatment extends over too long a time to satisfy either the physician or the patient. Therefore, in cases of this group radium should be used only in exceptional instances.

One hundred and seven of the 183 cases of this series presented myomata varying in size from small tumors detected during the course of diagnostic curettage to ascertain the cause of bleeding, to massive growths extending above the umbilicus. There were only a few of the latter group treated, and practically all of them presented contra-indications to operation. The ideal type for treatment with radium is the small or moderate sized interstitial myoma. The primary result is uniformly prompt, and recession in the size of the growth, while variable, is sure. The diminution is usually more than 50 per cent. The growth is frequently reduced to a negligible affair, and often entirely disappears.

Submucous growths, while responsive to radiation, should be selected with extreme care, owing to their known tendency to infection and sloughing after intra-uterine manipulations. In our series two of the earlier cases of this type developed pyometra, and one of them eventually required a hysterectomy. The size of subperitoneal growths is influenced least of all, and it has also been noted that radium has less effect in reducing the size of myomata in women beyond the menopause. Our best results appear to have been obtained in women presenting a history of severe menorrhagia.

It is apropos to mention here the technique followed in the application of the radium. Preliminary curettage should precede the application in order to permit a careful bimanual examination under anæsthesia, to eliminate small polypi, and to provide for a microscopic examination of the uterine scrapings.

The radium is introduced into the cavity of the uterus screened by brass and rubber or frequently a celluloid capsule, and is left *in*

situ from 3 to 24 hours, according to the indications. The average time of exposure in our series in young women—those under 38 years of age—was 12 hours in cases of myomata. In women beyond this age, where it was not so important to preserve menstruation, the treatment lasted 24 hours. As a rule, 50 milligrams of the radium element was employed. This dosage produced permanent cessation of menstruation in women over 40 years of age in 94 per cent of the cases. In our earlier work a second exposure was made within 10 days or 2 weeks, but it was soon observed that this was unnecessary, and often caused discomfort that was persistent, and occasionally very distressing.

At present we believe that one application is sufficient, and that subsequent exposures should be given only as indications develop. The recession in the size of the growth may be surprisingly rapid, or it may be gradual. Again, the growth may appear unaffected for several months, and then suddenly show a rapid shrinkage. For this reason, repeated exposures should be cautiously advised, and repeated examinations should be made to check the status of the tumor. Lately we have preferred to make 15-hour exposures, and to repeat the application in 3 or 4 months if it is necessary. We have found that, even after reducing the exposure, the single application is usually sufficient. This permits of its use in younger women, since our experience has shown that in many cases menstruation will reappear in several months, or as late as 2 years, and continue normal thereafter. Furthermore, the menopausal symptoms are apparently less marked when the shorter exposures are employed.

One hundred and two of the 107 cases reported complete relief from hæmorrhage within 5 months after radiation. Two of the remaining five required a second application before being relieved. Two others were not relieved by a second exposure, and the remaining case was eventually subjected to hysterectomy in another clinic. These figures practically correspond with the results obtained by other observers, and prove conclusively that no other agent at our disposal equals radium in controlling excessive uterine bleeding.

It has already been mentioned that the effect on the size of the tumor is variable. Fifty-seven cases returned within 5 years for other conditions, or for examination. In 37 of these the growth could not be determined at the subsequent examination, or was so reduced as to be classed as negligible. In two instances massive growths, as large as a 7 months' pregnant uterus, had shrunk below the umbilicus. Radium had been used in order to control bleeding because these patients were temporarily bad surgical risks. Both were sufficiently improved by the treatment to permit of successful operation at a later date. Reports were obtained from the balance of the series either directly from the family physician, or from the patients, who reported the findings of their medical attendants, and these records practically correspond with those in the cases under my personal observation.

In outlining the limitations of radium, too much stress cannot be placed upon eliminating chronic pelvic infection. Latent infection is so prone to be fanned into activity by radiation that no case is selected for this treatment when doubt exists as to its presence. In four cases in this series, all of which occurred in our earlier work, this truth was not appreciated. In two cases pelvic suppuration followed, requiring vaginal drainage; one required a hysterectomy after a prolonged siege of pelvic peritonitis; and the fourth case was an invalid over a period of several months.

It was further noted that patients who complained of pain associated with myomata were not usually relieved of that symptom even when bleeding was controlled, and the tumor partially reduced by radiation. This symptom is frequently attributed to pressure, but certainly pressure cannot always be the cause, else the pain would disappear as shrinkage occurs. This has happened so often that now we usually advise the patient that the bleeding will cease, the tumor may shrink, but that we cannot promise that the pain will be relieved.

Seventy-six of the 183 cases were instances of myopathic hæmorrhage such as are commonly classified as chronic metritis, hyperplasia,

fibrosis, uterine insufficiency, and so forth, conditions most frequent in women approaching the menopause. In this type, radium more nearly approaches the ideal specific than any therapeutic agent at our command. For merly, hysterectomy was the only satisfactory method of dealing with these conditions. At present it may be stated without exception that the surgeon who advises hysterectomy in uncomplicated cases of this group, when radium is available, is hardly acting in the best interests of his patient.

Fifty-eight cases of this last group were between the ages of 38 and 54 years. More than half had been subjected to all the measures usually employed, except hysterectomy. All received practically the same dosage, viz., a 24 hour exposure from a tube containing 50 milligrams of the radium element, as all of them had arrived at the age when it was not essential to preserve the physiological function. Four of them required a second application within 2 years for recurrent hæmorrhage, and were eventually cured.

Eighteen cases were between 15 and 36 years of age, 5 of them being between 15 and 18. The five instances of severe hæmorrhage in the women between 15 and 18 are of special interest. All had been treated by rest, tonics, glandular extracts, and repeated curettage without relief, and the hæmorrhage was so severe in one case that preparations had been made for transfusion. Three to 8 hour exposures with 25 milligrams of the radium element produced a temporary amenorrhœa, and menstruation was re-established in all cases within 14 months. In four cases it was perfectly normal. Since we do not know the ultimate effect of radium on the ovarian structures, it should be used only as a last resort in women of this age. In the cases reported it was used only after every other measure had failed to give relief, and the final results were a signal triumph for radiation.

Of 18 cases under 35, in which it was desirous of controlling bleeding without producing permanent cessation of menstruation, radium was applied from 8 to 12 hours until from 200 to 800 milligram-hour exposures were given. Six ceased to menstruate promptly; 4 of these reported a return in 1 year, which in one case was quite profuse; in the other cases it was perfectly normal. Five cases continued to menstruate scantily, the flow lasting the normal duration of previous periods. In four instances the flow was reduced and remained regular. Three cases menstruated irregularly, reporting scanty periods every 2 or 3 months.

Three pregnancies were reported in the series. One woman was delivered of a premature healthy baby at 8 months. The second case aborted at the fourth month. The third case is now 8 months advanced in pregnancy. An interesting feature of the cases of pregnancy is that in two instances there had been a period of sterility preceding the treatment, in one case of 3 years, in the other of 8.

When it was desirous of controlling bleeding in women over 40 years of age and full dosage was used, immediate cessation of menstruation followed in 20 per cent of the cases. Sixty per cent menstruated once, 15 per cent menstruated irregularly, and the balance reported no relief and have since returned for a second treatment. The second treatment was successful in all but three instances, and two of these three were relieved by a third exposure.

Profuse leucorrhœa was noted in about 20 per cent of the cases, and a slight but persistent discharge was reported in 30 per cent. In about 40 per cent it was absent, or was so slight as to cause no comment. Not infrequently radium cured or markedly diminished a leucorrhœa which was present before its application. The leucorrhœa as a rule rarely lasted longer than 6 or 8 weeks, but in several instances it was persistent after a year.

A few of the patients were operated upon subsequent to radiation. Four of them had radium preliminary to operation in order to improve their status as surgical risks. Two developed pyosalpinx and both required hysterectomy. Two continued to complain of pain and submitted to operation for relief. Two others became discouraged and submitted to operation before sufficient time had elapsed to test the effects of radium.

Subsequent reports as to the menopausal symptoms are interesting. In women over

40, in whom preservation of function was not considered important, about 60 per cent reported flushes and the usual phenomena of the climacterium. In about 20 per cent the symptoms were reported as severe, and almost invariably these cases had given a history of bleeding of the aggravated type. The duration of symptoms lasted about the time of the normal menopause, but in two cases the flushes were very severe and have persisted for 6 years. The patients in their latest reports state that the flushes are as frequent and as severe as they were during the first 4 months following radiation.

This brief review of cases extending over a period of 7 years reasonably warrants the conclusion that a large percentage of the cases of myoma of the uterus formerly subjected to operation can be permanently and safely relieved by radium, and that practically all cases of uncomplicated essential hæmorrhage can be cured by radium.

CRANIAL NERVE PALSIES PRODUCED BY TUMORS IN THE REGION OF THE JUGULAR FORAMEN

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THREE cases of unilateral paralysis of the larynx with involvement of the last four cranial nerves of the same side were selected to report because the paralysis in all of them was due to extracranial tumors. In two cases the paralysis was due to tumors arising from the deep portion of the parotid gland in the retromandibular fossa, and in one case to a lesion in the region of the jugular foramen, the exact nature of which is not known. A tumor was removed by operation in one case only (Case 285410).

Case 1 (285410). Mr. A. W., age 35, came to the Mayo Clinic, August 21, 1919, because of deafness in the right ear. On examination polyps in the right ear and a small mass below the ear were found. The polyps were removed and radium was applied to the mass.

The patient returned to the Clinic October, 1920. He was still deaf and often during 15 months had had dull pain below the right ear. For 8 months he had had headaches in the right temporal region extending down below the ear, and paræsthesia of the right side of the tongue. For one year he had been unable to swallow dry food. He had been hoarse for 10 weeks.

Examination revealed the right cord to be fixed, and a collection of mucus in the right pyriform fossa. On further examination the right pupil was found to be somewhat smaller than the left, and the reflexes and fundi negative. There was almost complete motor paralysis of the right half of the soft palate; the right vocal cord was paralyzed and the voice hoarse and nasal. There was moderate paresis of the right sternomastoid muscle, atrophy and fibrillary tremor of the right trapezius muscle, and fibrillary twitchings and slight atrophy and paralysis of the right half of the tongue. A diagnosis was made of paralysis of the ninth, tenth, eleventh, and twelfth cranial nerves with partial paralysis of the sympathetic nerve, due to a tumor in the retromandibular space.

November 13, 1920, operation was performed (Adson). The tumor was removed by the technique described herein. The patient recovered uneventfully except for slight weakness of the right facial nerve which was injured during the operation. In a report 10 months after operation the patient stated that his voice and the ability to swallow had improved somewhat, but the right half of his tongue was still paralyzed.

Case 2 (348444). Mrs. N. B., age 42, came to the Clinic February 3, 1921. She had had ulcer of the stomach 15 years before; a gastro-enterostomy had been performed in 1915 with partial relief of symptoms. She had had migraine with attacks of vomiting and vertigo for about 28 years. For the last 8 years she had been partially unconscious during attacks, probably migraine syndrome. For the last 6 years she had had attacks of choking and coughing; these had been much worse the last 2 years; occasionally while talking she had a catching sensation in her throat. Her voice was husky and at times lost. The right side of her tongue had felt thick and stiff for about 18 months.

Examination revealed slight enlargement of the heart to the left with systolic murmur transmitted

Fig. 1. Tumor after the sternomastoid had been reflected and before the mastoid process, stylohyoid, and posterior belly of the diagastric had been reflected.

to the axilla. Examination of the ear was negative. Examination of the blood revealed secondary anæmia; the hæmoglobin was 30 per cent; the erythrocytes were 3,170,000, the leucocytes 5,800; the differential count was normal. The Wassermann reactions on the blood and the spinal fluid were negative. Roentgenograms of the chest revealed thickened pleura at the right base. Between the angle of the right jaw and the mastoid process was a hard fixed mass. The pharyngeal wall bulged slightly inward posterior to the tonsil on the right. The patient coughed on pressure on the external tumor. Further examination revealed ptosis of the right eyelid, the right pupil smaller than the left, diminished reflex to touch on the right soft palate, partial motor paralysis of the soft palate and pharyngeal muscles, and paralysis and marked atrophy of the right side of the tongue. Speech was slurred and dysarthric. The right vocal cord was completely fixed. There was marked anæsthesia over the right half of the soft palate, right pharynx, and larynx. Practically all deep reflexes were increased.

A diagnosis was made of tumor in the region of the jugular foramen, and paralysis involving the ninth, tenth, twelfth, and probably the eleventh nerves. On account of the anæmia and the poor condition of the patient, radium treatments were given. The patient, in a report seven months after her visit to the Clinic, states that she is somewhat improved but that the tumor is still present.

Case 3 (361632). Mrs. G. L., age 40, registered at the Clinic June 15, 1921. Seven years before, following the birth of her last child, she noticed slight difficulty in swallowing; this gradually increased and then improved. Six years before she had had occasional occipital headaches. Four years before she had become hoarse and had noticed wasting of the right shoulder and moderate aching of the right side of the neck and back. One year before her tongue had begun to feel thick and troubled her in speaking. All of her teeth had been removed recently.

The general physical examination, the Wassermann reaction on the blood, and the roentgenograms of the cervical spine were negative. Further examination revealed the pupils, the fundi, and hearing to be normal. The right soft palate was atrophied and paralyzed, the pharynx on the right side was anæsthetic. The right sternomastoid and the trapezius muscles were atrophied; the right side of the tongue was atrophied and paralyzed, and the serratus magnus and suprascapular and infrascapular muscles on the right side were atrophied and partially paralyzed. There was a questionable mass in the region below the ear posterior to the ascending ramus of the jaw.

A diagnosis was made of incomplete paralysis of the ninth, tenth, eleventh, and twelfth nerves on the right side and partial atrophy of the supraspinati and infraspinati on the right side, and a lesion in the region of the right jugular foramen. Because of the length of time symptoms had been present, and the questionable tumor, it was thought inadvisable to explore at this time and radium was applied over the region of the tumor. The patient was dismissed to be observed by her home physician. A report from her October 1 stated that there was no change in her condition.

The recognition of unilateral associated laryngeal paralysis dates from Jackson's first description, in 1864, and since then the condition associated with paralysis of the soft palate and tongue on the same side has been described as Jackson's syndrome. In 1891, Avellis described a group of cases presenting the syndrome of palatolaryngeal hemiplegia. In 1897, Schmidt described still another combination of paralyses associated with laryngeal hemiplegia. Vernet recently called attention to a combination of unilateral paralysis of the three nerves passing through the posterior lacerated foramen. Collet reported unilateral extracranial paralysis of the last four cranial nerves resulting from injuries. Numerous combinations of unilateral paralysis of the larynx, associated with paralysis of one or more of the last four cranial nerves, may be encountered. Some of these have become classic.

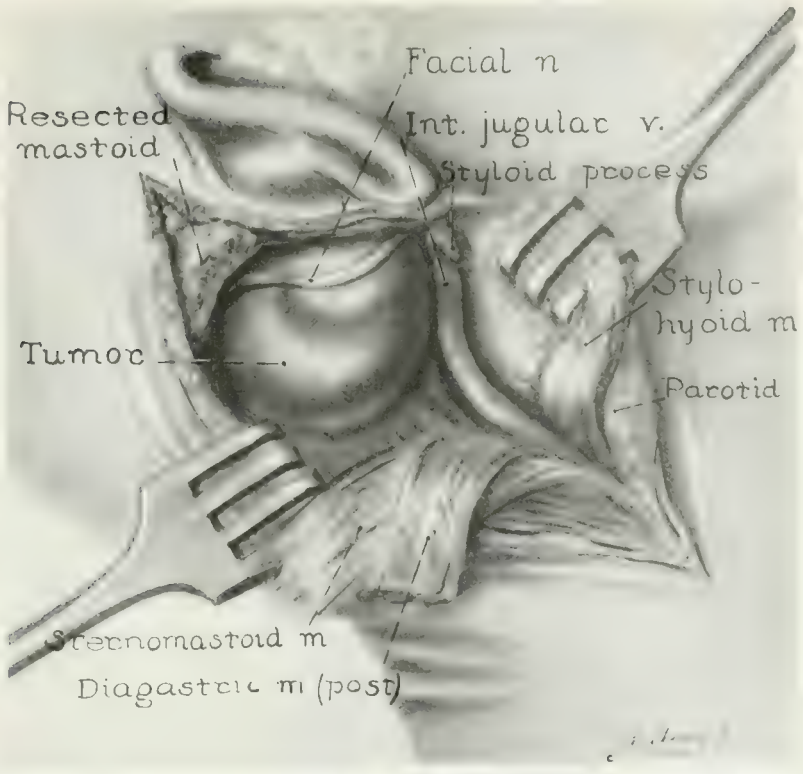

Fig. 2. The tumor after part of the mastoid process, petrous portion of the temporal bone below the auditory canal have been ronguered away and the stylohyoid and posterior belly of the diagastric muscles reflected.

CLASSIC SYNDROMES

	Hemiplegia of larynx	Hemiplegia of soft palate	Hemiplegia of tongue	Hemiplegia of sterno mastoid and trapezius
Syndrome of Avellis	+	+	+	−
Syndrome of Schmidt	+	+	+	+
Syndrome of Jackson	+	+	+	−
Syndrome of Topia	+	+	+	−
Total syndrome (Collet) of last four cranial nerves				

In Case 1 the last four cranial nerves were involved. Case 2 was similar to Case 1, but the external branch of the spinal accessory nerve was apparently not involved. In Case 3 the last four cranial nerves on the right side were paralyzed, and there was slight atrophy and weakness of the serratus magnus and supraspinatus and infraspinatus muscles on the right side.

It is often difficult to make a diagnosis, and at times it is impossible to differentiate the extracranial lesions of the last four cranial nerves from bulbar or intracranial lesions, but usually in cases of intracranial lesions other symptoms referable to involvement of part of the cerebrospinal nervous system, such as hemianæsthesia, hemiparesis, and hemiataxia are present.

The exact nature of the lesion in many cases reported under Avellis', Schmidt's, and Jackson's syndromes is doubtful, since in many instances the diagnosis was not verified by operation or necropsy. Some of the verified extracranial lesions which produced unilateral associated laryngeal paralysis were due to aneurisms in the region of the jugular foramen, causing paralysis of the last four cranial nerves. One case was probably the result of tuberculous glands in the retromandibular fossa, producing the syndrome of the posterior lacerated foramen. Many cases were due to trauma, stab wounds, and

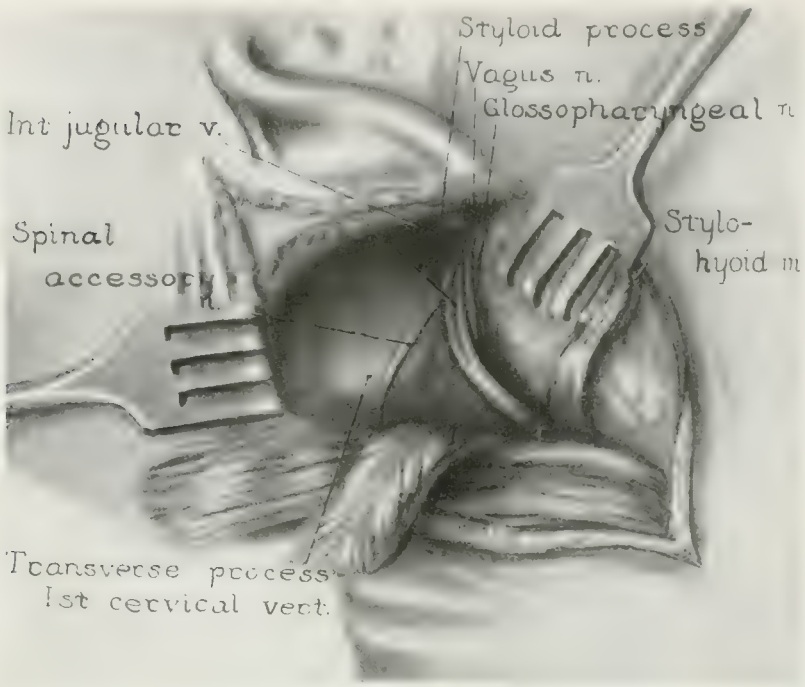

Fig. 3. The bed of the tumor with the nerves and jugular vein on which pressure had been made by the tumor.

gunshot wounds in the region of the base of the skull, while others were due to inflammations, nasopharyngeal neoplasms, and syphilitic extracranial lesions. I was unable to find a report of such cranial nerve palsies caused by tumors of the parotid.

TECHNIQUE OF OPERATION

The method of exposing the region of the jugular foramen in Case 1 was as follows: An incision was made along the anterior border of the sternomastoid muscle, extending well up along the anterior border of the mastoid process. By retracting the anterior border of the sternomastoid backward and by dissecting forward, a well-encapsulated tumor was exposed posterior and medial to the ascending ramus of the jaw, and anterior and medial to the mastoid process below the lower bony wall of the external auditory canal and medial to the stylohyoid and posterior belly of the diagastric muscles (Fig. 1). The mastoid process was ronguered away together with part of the temporal bone below the auditory canal. The bellies of the stylohyoid muscle and of the diagastric muscle were divided and reflected in order to obtain exposure (Fig. 2). Posteriorly the tumor was in contact with the transverse process of the atlas; it arose apparently from the deep portion of the parotid gland. The ascending ramus of the jaw anteriorly and laterally, and the mastoid process posteriorly, prevented the tumor from bulging outward in its growth, and as a result it pressed against the structures that pass through the jugular foramen (Fig. 3). The tumor was removed by careful dissection, with the capsule intact, except a small projection which extended up through the jugular foramen along the jugular vein. This part was curetted away, and the entire cavity packed with gauze saturated in Harrington's solution. Pathological examination of the tumor revealed mixed tumor of the parotid.

SUMMARY

In the three cases described, cranial nerve palsies resulted from tumors in the region of the jugular foramen. In two of the cases the

tumor arose from the deep portion of the parotid gland and in enlarging, extended to the region of the jugular foramen. Attention is directed to the fact that extracranial tumors or other lesions in the region of the jugular foramen are accessible and may be removed surgically. If the tumors are of the mixed parotid type, they are encapsulated in the early stages, and during this stage surgical removal is the best method of treatment.

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CONGENITAL MEGACOLON IN ADULT

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THE occurrence of the so-called idiopathic dilatation of the colon in childhood is not exceedingly rare, but a well-authenticated case of congenital megacolon in the adult is sufficiently unusual to merit description.

Mr. A. F., age 26, had been obstinately constipated since birth. Enemata became gradually less effectual. Recently the bowel has been emptied by a physician at intervals of 3 or 4 months, when severe abdominal cramps demanded relief. A general feeling of "heaviness" and a tired feeling in the legs preceded the cramps. Twice he has been compelled to have his rectum unpacked in a hospital; the absence of subjective symptoms was remarkable; the family history as regards similar trouble was negative. He was a fairly well-nourished young man, apparently of low mentality; pallor was marked; his tongue was heavily coated, and his breath foul. Inspection revealed prominence of the entire left half of the abdomen; here, the percussion note was dull, elsewhere it was tympanitic, although the abdominal walls were flaccid. A rounded, solid, painless mass could be palpated in the left upper quadrant. Physical examination was otherwise negative.

The X-ray examination by one of us (Davidson), revealed chest and œsophagus, normal. Stomach apparently hypertonic in type, and appears turned upon itself in such a manner that the lower border is represented by the concave lesser curvature, and the upper border by the convex greater curvature. There is nothing to indicate any irregularity in outline of either the lesser or greater curvature. Pylorus, normal location; its outline is not distinctly observed. Duodenum, normal.

Four-hour examination shows no gastric retention. Twenty-four hour examination shows all the ingested barium in the ascending colon on the right side. The colon itself, in this region, appears somewhat elongated, but not dilated. The cæcum appears regular in outline. A small appendix is outlined.

Forty-eight-hour examination shows no change in the position of the barium. Clysma: 2½ quarts of solution were allowed to flow into the rectum. The outline of normal colon is not observed. The clysma solution drops into what appears to be a bag, which seems to fill the entire abdominal cavity. This pouch or bag appears regular in outline, except at one point on either side, where there appears a slight indentation. This pouch seems to have no connection with the ascending colon, since none of

the clysma solution seems to enter the ascending colon directly from the pouch. The ascending colon retains the same outline that was observed during the previous examination.

The rectum, which seems to be only about one-half the normal length, is directly continuous with this large pouch.

Operation August 6, 1921. Through a left rectus incision, an enormously distended loop of bowel was delivered with some difficulty from beneath the diaphragm. It proved to be the redundant sigmoid. The dilatation and hypertrophy extended downward, involving the rectum, and upward along the descending colon. At the lowest accessible point where section was made, the rectum approximated 7 inches in its flattened diameter. Two clamps above, and two below, were required for occlusion. Division was made with the Percy cautery. The diameter of the rectum and the thickness of its walls complicated closure. The withdrawal of the two clamps during traction upon the inverting suture proved an awkward procedure, and slight leakage occurred. The proximal section was made through the normal descending colon. A colostomy was placed slightly below the level of the umbilicus, in the upper third of the incision. (Re-establishment of the intestinal continuity will be undertaken later.)

Convalescence was uninterrupted, save by the slow healing, due, apparently, to fæcal contamination of the incision. The improvement in mentality was immediate and astonishing.

Examination of gross specimen. The excised bowel was dull white in color and of the consistency of leather; weight 3900 grams; circumference 47.5 centimeters in middle; length of enlarged portion 40 centimeters; entire specimen 60 centimeters; circumference at lower cut end, 36 centimeters (entire dilated portion could not be removed); capacity after fixation 2250 cubic centimeters; estimation of original capacity, 2880 cubic centimeters. The wall was thickened; rugæ of mucosa very large; vascular supply abundant; mesosigmoid greatly thickened; neither pigmentation, so generally observed, nor ulceration of the mucosa were present. (No proper conception of the size or capacity of the dilated colon can be formed from the laboratory measurements of the excised segment.)

Microscopical examination. Submucosa very loose and thick; vessels of submucosa very large; slight increase of round cells and polymorphonuclears in submucosa. Muscular wall very much thickened.

The term megacolon, from the etiological viewpoint, is generally applied to the presumably congenital and idiopathic dilatation and hypertrophy of the large bowel which bears Hirschsprung's (20) name. Finney (13) reminds us, however, that several reports of the condition had appeared in the literature prior to Hirschsprung's original contribution in 1887. The designation, then, of "Hirschsprung's disease," appears to be a tribute to careful observation and description.

Hirschsprung believed, since the constipation began at birth, that the "evil lying at the root, must be considered either as an anomaly of development, or a pathological fœtal process." Mya (37), however, considered the dilatation congenital, but the hypertrophy secondary. Treves (52) thought that all cases were due to obstruction. Hawkins (17) was of the opinion that a neuromuscular defect was responsible for megacolon, an opinion concurred in by Mayo (34); and Perthes (41) viewed valve formation as the important etiological factor. Kauffman (28) divides congenital megacolon into two groups, one conforming to the theory of Hirschsprung, the other comprising instances of unusual length of the sigmoid colon, with the formation of loops and valve-like closures, or pressure by one loop upon another. Marfan (32) contends that the malady is due to the unusual length of the sigmoid, with the formation of kinks and the "valve lock."

The existence of an abnormally long mesentery, connective tissue hyperplasia of the rectum, chronic colitis, spastic contraction of the sphincter, and increased length of the sigmoid are additional theories of etiology, gathered from the literature by Finney, who states that no single factor accounts for all the cases. Finney believes that lymphangiectasis is of great etiological importance. Aschoff (2) more recently wrote: "Enlargements of the intestinal canal usually appear above stenoses; commonly, the dilatation, if its onset is not too acute, is accompanied by a work-hypertrophy of the musculature. These dilatations may attain an enormous size, especially in stenoses whose onset has been gradual or involving a valve. To the last group probably also belongs Hirschsprung's disease, the megacolon (Heller, Konjetzny, Perthes, Schmidt).

"According to most observers, it here conducts itself as a valvular shutting at the juncture of the abnormally long sigmoid flexure in the rectum. It is a congenital anomaly, which gives rise to a high-grade dilatation and hypertrophy of the whole

Fig. 1. The unusual position of the stomach is explained by Figure 2.

Fig. 2. The giant sigmoid in comparison with the normal ascending colon.

colon, by which the belly of the child is powerfully distended and its nourishment finally seriously endangered."

This description of megacolon is quite generally accepted, though in many of the reported cases, the sigmoid alone is involved.

Somewhat analogous to the "valvular shutting" of Aschoff, is the "angulation at the sigmoid" described by Delatour (11). Cantlie, according to Delatour, ascribes to the constriction at either end of the sigmoid, a definite sphincteric action. Delatour conceives spasm here with resultant slowing of the fæcal current, and a bending or sharp angulation of the heavy, redundant sigmoid at the rectosigmoid junction. Intestinal stasis is thus perpetuated and a definite syndrome established. The condition is demonstrated by roentgenography and the symptoms are relieved by resection of the sigmoid. Angulation, then, links the symptomless, functioning redundant sigmoid with the true megacolon. It is significant that Delatour notes the occurrence of the angulated redundant sigmoid in childhood, with the statement that the child had always been constipated.

Meyers (35) pertinently inquires what degree of hypertrophy and dilatation constitutes the so-called Hirschsprung's disease. The roentgenograms of all cases of persistent constipation show that many of the sigmoids are looped, twisted, redundant, dilated and hypertrophied, and the past histories of these cases are practically identical. Wagner (53) observes that the anatomical arrangement of the fixed rectum and the mobile sigmoid invites kinking.

Wilkie (57) cites the case of a man 60 years old, who had always been constipated. At operation the pelvic colon only was involved and there was evident kinking at the rectosigmoid junction. Wilkie believes that "an exaggeration of the long sling-like pelvic colon, found normally in the infants, is the cause of the disease." There is no evidence that hypertrophy is found at birth, as contended by Hirschsprung and Kredel, but a kink or valve forms by sagging, with subsequent dilatation and hypertrophy (Perthes).

Fig. 3. The excised segment, contrasting the hypertrophied and the normal parts of the bowel.

Bensaude and Sorrel (5) state that an abnormally long loop of bowel is frequently abnormally large in every direction. The sigmoid flexure is almost invariably involved in megacolon. Bensaude and Sorrel found a kind of valve at the upper end of the rectum formed by simple kinking of the bowel.

Hoffman (21) believed that volvulus and chronic kinking of the lengthened and dilated sigmoid loop were the causes of Hirschsprung's disease in ten instances.

Bailey (3) concludes that megacolon may be due to any congenital defect that produces stasis, either through mechanical or neuropathic interference with peristalsis.

Although Walker (54) defines megacolon as a condition in which no definite obstructive lesion is found at operation or necropsy, we contend, in view of the reported discovery of kinks and valve formations at the rectosigmoid junction, that the likelihood of the unrecognized existence of such obstructions should be admitted.

Marchand (33), in 1903, held the opinion that an early obstruction might result in dilatation, and although the obstructive action soon ceases, a secondary hypertrophy, nevertheless, supervenes.

Daniel (10) reported the case of an infant whose imperforate anus was opened on the second day. Several years later Daniel operated for the relief of apparent megacolon. The susceptibility of the infantile colon to obstruction seems obvious.

Fenwick (12) notes that the appearance of the bowel in megacolon is exactly like that found above demonstrable obstructions, hence the process is not a congenital pathological entity, a view shared by Terry.

Granting the probability of a valve-like sigmoid obstruction, there must, in some instances at least, be another factor at work, since Ladd (29), Johnson (26), Stiles (48) and others have discovered enormous dilatation of the rectum also, at operation. Goebel (14) notes, in this connection, that surgeons are unable to demonstrate the cause of the dilatation which extends sometimes down to the anal ring. Goebel suggests that anal spasms might be severe enough to induce a reflex irritation leading to lesions analogous to those of megacolon. The local spasms of the sphincter might at least be considered a contributing cause to the colonic condition. Treatment, therefore, should aim to remove the tendency to spasm. The etiological importance of spasm was strikingly apparent to Popper (43), who was called to see twins 4 days old. One twin had died shortly before Popper arrived. The other appeared moribund with symptoms of shock, and an enormously distended abdomen. No meconium or flatus had been passed since birth, in spite of repeated enemata. A glass tube forced with some difficulty through the sphincter entered the roomy rectum. Pressure upon the abdomen forced meconium and flatus out of the anus and immediate relief of symptoms and reduction of the distention ensued. Since the dead twin had presented identical symptoms, Popper believed that both babies suffered from congenital megacolon. The diagnosis, in the case of the living twin, was subsequently confirmed by roentgenography.

Meyers reports six cases of dilatation of the colon in children from 4 to 9 years of age. The X-ray examination revealed sigmoid redundancy in each instance, plus megacolon in one. The obstinate constipation was entirely relieved in five instances, including the case of megacolon, by the administration of atropin, since the bowels functioned normally after discontinuing medication.

Fenwick observed spasms of the anal sphincter in a child in whom the dilatation and hyper-

trophy extended right down to the anus, and Holt (23) believes that the primary condition in megacolon is one of congenital hypertrophy, and that spasm is added to this.

Regarding the frequency of megacolon, Ladd, in January, 1921, collected from the literature 113 cases to which he added five of his own, making a total of 118. Ladd concludes, therefore, that the disease is uncommon. Hoffman (22), on the other hand, reviews 18 cases from Payr's service, which were operated upon during the 10 years preceding March, 1921, and believes that the condition is less rare than is generally assumed. Smith (47) gathered 392 reports to October 1, 1915. The discrepancy between the figures of Smith and those of Ladd may be accounted for by the fact that the latter considers the majority of the adult cases doubtful, since the history usually does not date back to infancy, or demonstrable mechanical obstruction exists. We believe that most cases of megacolon are probably reported, since the striking objective signs, the remarkable X-ray findings, the discovery at operation of a sigmoid limited in size, perhaps, merely by the confines of the abdomen and the subsequent surgical triumph or defeat, present a picture which invites description. It appears, therefore, that the publication of approximately five hundred reports during the greater part of a century, would indicate the infrequency of megacolon, particularly in view of the fact that many of the reports are based on a false premise (imperforate anus, for example), or lack roentgenographic, operative or postmortem confirmation.

A consideration of the age at which megacolon occurs, leads to the report by von Ammon (1), in 1842, of a case affecting a fœtus at the seventh month. Potter (44) states, however, that von Ammon's observation is incomplete. Finney cites several instances in which the abdominal distention of megacolon complicated delivery. Popper discovered the condition in twins 4 days old, and Ladd considers megacolon essentially a disease of childhood, an assumption based, naturally, upon the fact that Ladd's five cases came to operation at the ages of 2 months, and 3, 6, 7, and 9 years respectively.

Dilatations of the colon beginning in adult life, from whatsoever cause, have been termed "pseudomegacolon" by Hirschsprung. Johnson, however, considers such classification superfluous, if the term "megacolon" applies only when there is no demonstrable etiological factor. Popper believes that megacolon is exceedingly rare, if not unknown, in the adult, and Ladd states that it is occasionally possible for a patient to reach adult life with this condition, but that most of the cases reported in the adult do not give a continuous history from infancy.

The reports by Terry (50, 2 cases), Wilkie, Hubbard (24), Hawkins, Graves (16), Jackson (25), Herringham (18), and Johnson, of true megacolon in the adult, are well authenticated since the symptoms, in each instance, dated from birth or early infancy, and the diagnosis was confirmed at operation or autopsy. One patient, a man, was operated upon at the age of 78 years by Herringham. Hoffman, however, in reviewing 18 cases of megacolon, 16 of which affected adults, states that the picture of the disease may not develop until later in life. The relative frequency with which megacolon occurs in childhood and in maturity is suggested by the statement of Patel (40) that of 223 cases which came to operation or necropsy, only 73 were in adults.

The preconceived notion held by one of us (Fowler), that gigantism usually involved the entire colon, was proved erroneous by a survey of the literature. Among Ladd's cases, for example, there was only one instance in which the entire colon was involved; in three others, the descending colon and the sigmoid were affected, and in the fifth, the rectum, sigmoid, and descending colon were involved. Puls' (45) analysis of 104 cases revealed the sigmoid alone involved in 35 per cent, the entire colon in 27 per cent and the sigmoid either alone or with other segments in 84 per cent. Mummery (36) noted that the sigmoid was chiefly affected in 80 per cent of the cases. In Hirschsprung's two original cases, the sigmoid was chiefly involved. Neugebauer (38) stated that the sigmoid alone was the site of the disease in 74 out of 169 cases, and Barrington-Ward (4) found all sigmoids dilated in 19 autopsies on children. Brewer (7), in

writing of megacolon, states that there is chronic dilatation of the sigmoid and even of the greater part of the descending and transverse portions of the colon. Blake (6) found the upper rectum and sigmoid enormous in a woman 24 years old, and the mesosigmoid was so long that the sigmoid loop could be lifted 15 inches outside of the abdomen. Finney observed that in more than one-third of the cases, the sigmoid alone was involved, and in practically all instances it was included; and Judd (27) believes that in practically all cases, the large bowel is involved and especially the sigmoid.

Regarding the relative frequency with which megacolon affects the sexes, Mummery records a prevalence in males, in the proportion of 3 to 1.

Although a familial tendency is exceedingly rare, Popper reports the occurrence of megacolon in newborn twins. More striking, perhaps, is the observation by Graves of an instance of this malady in a woman 21 years old, whose sister had died in infancy without a normal evacuation. Welt-Kakels (56) reported a similar case of colonic dilatation in an adolescent boy whose brother had died at the age of 8 years, without having had a normal movement. Machell (31) presents a well-authenticated example of the familial tendency in his report concerning two brothers. Operation upon the elder, at the age of 3 years, revealed dilatation of the entire colon and the rectum. Necropsy on younger on fifteenth day disclosed dilatation of the entire colon with some thickening of the bowel wall. Finney cites three instances of familial megacolon.

The symptomatology of megacolon, according to Popper, consists of obstinate constipation, marked distention and active, visible peristalsis, finally accompanied by signs of intestinal toxæmia, and usually resulting in early death. This active, acute process begins at birth or soon after, and the dilatation and hypertrophy are present from the start. Popper believes that a milder type, beginning in early childhood and characterized by abdominal enlargement and severe constipation, is probably acquired. Most observers, however, consider the latter type true megacolon pursuing a chronic course.

Stiles has observed children a few months old in whom constipation has been obstinate since birth and the mothers state that the constipation gets gradually worse and worse and the abdomen gets bigger and bigger. The bowel movements, at intervals of 2 or 3 weeks, are loose and accompanied by colicky pains. Such diarrhœa is usually of short duration and is well tolerated, but the terminal type observed by Hirschsprung is profuse and continuous with increasing prostration, until death.

Although vomiting is unusual, Ladd notes that when the toxæmia markedly increases, periods of vomiting and accentuated distention occur and dyspnœa and cardiac embarrassment may ensue. Such attacks demand prompt relief. The typical picture, according to Ladd, is that presented by an emaciated child with a prominent abdomen; the veins of the abdominal wall are conspicuous; the dilated coils of the colon are apparent and masses can be felt within them. The skin, except over the abdomen, is loose and dry, the complexion sallow and the facial expres sion dull. Enemata and catharsis are followed by copious, offensive stools. The X-ray picture succeeding a barium enema confirms the diagnosis.

Although Peskind (42) observes that the worst feature of megacolon consists of progressive nutritional disturbances, the disease, nevertheless, frequently pursues a decidedly chronic course. Indeed, Finney, in accord with general opinion, considers the malady to be essentially chronic. There is often, as noted by Stiles, Johnson, and others, a remarkable lack of subjective symptoms, with good appetite, apparent good health, and even gain in weight provided the bowel is kept relatively empty.

The reaction to constipation varies. Hirschsprung treated an infant 7 months old, who had had but one insignificant movement in 2 weeks, yet the baby seemed free from ailment. Linde (30), on the other hand, noted signs of toxæmia or convulsions in his three-and-a-half-years-old patient, if 5 days were allowed to pass without an evacuation. Generally the immunity from toxæmia in the youthful sufferers from megacolon is surprising.

Adults, however, develop even more striking immunity since stool-free periods of weeks or even 3 to 4 months, induce only moderate auto-intoxication; mental torpor, however, is constant during fæcal retention.

Instances of acute obstruction of the redundant sigmoid, usually volvulus, have been reported. In the case described by Critchlow (9) of a man 42 years old, there had been several previous obstructive attacks. At operation Critchlow observed that the enormously dilated sigmoid loop had been forced by its gaseous content to the lateral and upper confines of the abdomen and the base of the loop was twisted. The affected bowel, unlike the uncomplicated megacolon, did not present in the incision. (This volvulus and the consequent remarkable distention of the sigmoid loop is beautifully illustrated in Hirschman's (19) book.) Nuzum (39) reports the occurrence of acute obstruction of another type in a child 6 years old, who had always been obstinately constipated. At operation for the relief of acute symptoms, megacolon and an obstruction due to kinking of the sigmoid in the pelvis were observed. The enormous accumulation of fæces in the descending and pelvic colon of a 10-year-old sufferer from megacolon was the unusual cause of acute obstruction in a case reported by Tewfik (51).

Hypertrophy is usually but not invariably present, since Cadwallader (8) and Hawkins, for example, each report a case of undoubted megacolon in which dilatation without hypertrophy was manifest. In both instances the bowel was markedly dilated and thinned by gaseous distention. In this connection Wilkie states that, in the adult, dilatation can only follow the failure of the compensatory hypertrophy. We believe, however, that the free or slightly obstructed redundant sigmoid may remain for years unchanged in its caliber, and in the thickness of its walls, but a suddenly increased obstruction at any time would be followed by dilatation of the bowel and a thinning of the wall.

The diagnosis of megacolon in childhood, according to Ladd, should be relatively simple since the conditions which simulate it, chronic indigestion with constipation, rickets, tubercular peritonitis and acute obstruction present, each, a different picture in its entirety. The recognition of the malady in adults, also, Finney observes, is ordinarily not difficult since it is to be differentiated from tubercular peritonitis, some forms of chronic ileus, annular carcinoma of the intestine, dysenteric ulceration, ovarian cysts, etc.

Of importance, too, in the differential diagnosis is the observation made by Finney that ascites does not accompany megacolon. Although abdominal distention and obstinate constipation with freedom from objective symptoms are pathognomonic of the disease, we are reminded by Peskind that there may be quite regular evacuations, even eight or ten daily, without appreciably decreasing the fæcal retention, a seeming paradox explained, Ladd says, by the fact that the liquid fæces finds its way around the solid masses without dislodging them.

The treatment of megacolon seems essentially surgical yet Ladd discovered to his surprise, that the surgeons suggested medical treatment and the clinicians advised operation. Dietary regulation and improvement of hygiene with measures designed first to empty the bowel and second to establish normal peristalsis, are the requisites of medical treatment. Meyers observed, in one case, a predominance of starches in the diet. A rational dietary and the administration of atropin resulted in apparent cure. Griffith and Crozer (15) believe that operation is indicated only when the health begins to suffer, and Ladd is of the opinion that nonoperative measures should be tried in the borderline cases before resorting to surgery. Peskind considers the treatment chiefly medical, operation being indicated only when the condition does not yield to rectal lavage or when obviously necessary in late cases to save life. Johnson, on the other hand, states that little is to be expected from medical treatment and one of us (Fowler) holds that the difficulty, if not impossibility, of bringing away the fæcoliths, is the chief bar to medical treatment. It is evident, also, in the pronounced case, that the widely dilated sigmoid which has become, in fact, a reservoir, could not reasonably be expected to empty

itself. Indeed, roentgenograms after medical treatment usually demonstrate that the size of the colon remains unchanged, although Meyers reported one instance in which the bowel did appear to be smaller following the administration of atropin in a case of moderate severity. The delay incident to a test of medical treatment would ordinarily be harmless, even though such treatment proved ineffectual, since the systemic disturbances of megacolon are transitory and disappear with the relief of the stasis. In the advanced case, however, medical treatment at best accomplishes merely partial removal of the retained fæces at intervals. Between times, the patient is mentally sluggish with consequent decreased earning capacity, if an adult, and lessened enjoyment of life. The dictum of Ladd, that operation should be unhesitatingly advised in such instances, should, therefore, be generally accepted.

Surgical treatment aims, of course, at removal of the functionless bowel and restoration of the intestinal continuity. The procedures vary according to the preference and judgment of the individual surgeon. For example, Johnson favors the single stage operation, whereas Finney advocates a preliminary colostomy with secondary resection and anastomosis. Johnson reminds us, however, of the liability to fæcal contamination during operation due to the difficulty of pre-operative drainage of the liquid fæces from the colonic reservoir. Ladd, also, recognizes the danger of contamination, since the ordinary types of intestinal holding clamps fail to occlude the hypertrophied bowel. Only the heavy crushing clamps of Payr are effectual. In the event of leakage, the anastomosis must, of course, be deferred. Johnson performs an end-to-end anastomosis with partial closure of the dilated lower segment, but Ladd prefers an end-to-side union. Ladd emphasizes, also, the importance of passing a rectal tube through the anus and up beyond the anastomosis. Resection and anastomosis in one stage, provided the patient's condition and faultless technique permit, is ideal. When good judgment dictates a less radical course, however, the stage or stages beyond the first will be complicated by adhesions. There can be no rule of procedure, since each case presents its individual problems. According to Wells (55), in writing of rectal carcinoma, "a colostomy is not the dreadful thing we used to think it was." Patients have warning when the bowels are about to move, and there is no soiling. In the treatment of megacolon, however, we contend that a permanent colostomy is seldom justified. If the patient is willing to assume the risk incident to the re-establishment of the intestinal continuity, the surgeon certainly should be. Patel reminds us that the surgical mortality in infancy is high, since under the age of 2 years, thirteen deaths followed thirteen operations, and after laparotomies between the ages of 2 and 5 years, only four of fourteen patients survived. Surgical treatment is not uniformly successful, since Hawker, Richardson (46) and Stiles each report a case in which dilatation recurred following operation.

A statistical comparison made by Ladd of the results of medical and surgical treatment in megacolon, is interesting. Sixty cases were treated medically with 41 deaths, a mortality of 67 per cent; 7 were cured, 12 per cent; 58 cases received surgical treatment with 24 deaths, a mortality of 41 per cent; 24 were cured, 41 per cent. Patel states that about 57 per cent of the 74 children, and 57 per cent of the 41 adults who were subjected to operation were cured. Ladd notes that the surgical deaths resulted from peritonitis, due to technical errors, rather than from intolerance of the operative procedures, *per se*. Neugebauer reported that medical treatment proved curative in only 1.5 per cent of 133 cases.

The prognosis of megacolon, according to Finney, is largely that of intercurrent diseases consequent to malnutrition. The patient leads a precarious existence with the greatest likelihood of a fatal termination in infancy. Stone (49) states that the deaths in early childhood are due to obstruction, volvulus, perforation, toxæmia, or exhaustion. Herringham, however, reports a death from perforation in a man 78 years old.

The admirably comprehensive survey of megacolon published by Finney in 1908

leaves little to be added. Nevertheless, the theories regarding the etiology are as numerous as ever. We thus find justification for this report and for a reassembling of the facts and fancies concerning megacolon together with an expression of our own views.

SUMMARY

There is scant clinical verification of the theory that megacolon is a congenital pathological entity. The normal tendency toward sigmoid redundancy in the newborn has been noted. The sigmoid is always involved in megacolon, and redundancy has been observed with striking frequency. The anatomical arrangement—fixed rectum and mobile sigmoid—invites functional obstruction at the rectosigmoid junction, and kinks and valve formations have been clinically demonstrated here. When such obstructions are not demonstrable, we may assume that they existed previously, since the dilatation and the hypertrophy encountered in the so-called idiopathic megacolon cannot be differentiated from those which follow organic obstructions.

CONCLUSIONS

1. The so-called idiopathic megacolon is relatively infrequent in childhood and rare in the adult.

2. The only congenital feature of megacolon is the redundant sigmoid.

3. The unobstructed redundant sigmoid may be nearly or quite symptomless.

4. The degree of obstruction, from whatsoever cause, determines the subsequent course.

a. Relatively slight obstruction (the "angulation" of Delatour) produces a definite syndrome without dilatation or hypertrophy.

b. Acute obstruction (usually volvulus), either primary or superimposed upon hypertrophy, induces sudden dilatation and the desperate picture common to such obstructions.

c. Chronic obstruction causes gradual dilatation and compensatory hypertrophy, the type described by Hirschsprung.

5. Kinking, or valve-like action at the rectosigmoid junction, is the usual cause of obstruction. When the rectum, also, is involved, anal spasm is a likely factor.

6. The surgical treatment of megacolon aims at removal of the crippled bowel and restoration of the intestinal continuity.

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Note.—The excellent paper by Dowd entitled "The Surgical Treatment of Megacolon," appeared in *Annals of Surgery* for October, 1921, after this paper had been accepted for publication.

PATHOLOGICAL FRACTURES[1]

By E. A. CODMAN, M.D., F.A.C.S., Boston

SINCE I have had little personal experience in the treatment of pathological fractures, my function has been to review the literature of this subject in order to give you in 10 minutes a résumé of present recorded knowledge concerning it. I will give a minute to each of ten headings.

1. The literature. Go to Eisendrath in Keene's *Surgery*. He will give you an excellent survey and quote largely from Grunert who reviewed the literature up to 1904 most thoroughly. If you want more references, the Registry of Bone Sarcoma has collected many for your service, but the articles contain little new except Bloodgood's dictum; "fracture as the symptom of onset in a central lesion suggests a bone cyst, and if the patient is 15 years of age or younger, it may be looked upon as almost pathognomic." This is likely to prove a diagnostic rule of permanent value.

2. Etiology. As secondary causes almost every human activity is mentioned; walking, running, coughing, sneezing, getting up or sitting down, and even turning over in bed. A pathological fracture implies a trivial cause acting on abnormal bone. I see no profit in listing these secondary causes, as they are not important in diagnosis, prognosis, or treatment, but we must in every case consider the possible pathological possibilities and not jump to the diagnosis of sarcoma too quickly. Eisendrath's table shows a list of possible causes.

EISENDRATH'S TABLE OF CAUSES OF PATHOLOGICAL FRACTURE[2]

1. Fractures resulting from bone fragility of local origin
   - A. Through tumors
     - a. Primary and metastatic sarcoma
     - b. Metastatic carcinoma
     - c. Adenocarcinoma from the thyroid (osseous metastases)
     - d. Enchondroma and benign osseous cysts
     - e. Metastatic hypernephroma
     - f. Echinoccoccus cysts
   - B. Inflammatory processes
     - a. Pyogenic osteomyelitis
     - b. Tuberculous osteomyelitis
   - C. Aneurisms
2. Fractures resulting from bone fragility due to some general disease
   - A. Neuropathies
     - a. Tabes dorsalis
     - b. Syringomyelia
     - c. Mental diseases (paresis)
   - B. Senile changes
   - C. Exhausting chronic diseases
   - D. Atrophy due to non-use
   - E. Scurvy
   - F. Rachitis and osteomalacia
3. Fractures resulting from idiopathic fragility of bone (osteoporosis. fragilitas ossium)

3. Pathology. These fractures differ from ordinary fractures in other respects than in the trivial cause. They are more apt to be bendings, bowings, bucklings, telescopings, and impactions. They are usually transverse, but may be oblique with one end of the fracture starting in the lesion. One such case in a true osteogenic sarcoma of the femur is recorded in the registry. As a rule the ends do not tend to separate widely or slip by one another. Yet they are not "greenstick" but rather "rotton wood" fractures. The ends have not life enough to spring into sharp fragments. These features probably account for the fact that such fractures are less painful than those in sound bones. This is particularly true in tabetic cases. I have not time to consider the pathology of the general lesions causing pathological fractures, for this symposium concerns sarcoma especially.

4. The pathology of bone tumors. Since pathologists cannot or will not give us a standard nomenclature of bone tumors, I will venture with a certain amount of levity a safe surgical one:

a. Osteitis fibrosa. This includes ordinary bone cysts and the hæmorrhagic osteomyelitis of Barrie and possibly my next heading.

b. Bloodgood's giant-cell tumor, called myeloma in Canada and in Europe. These are benign, but if they do not prove benign, they belong in my next heading.

c. Giant-cell sarcoma. I do not mean sarcoma with giant cells, but an epulis-like tumor with "foreign body giant-cells" and an histological appearance indistinguishable to a

[2] From Keen's Surgery, vol. ii, 83.

[1] Read before the Clinical Congress of American College of Surgeons, Philadelphia, October, 1921.

surgeon's eye from Bloodgood's giant-cell tumor, *but which eventually proves malignant.* The Registry of Bone Sarcoma is putting Bloodgood and Ewing on trial to see whether it is possible to discard this heading.

d. True osteogenic sarcoma whether central or periosteal, for they are usually more or less both. These are definitely malignant, and as a rule easy to recognize clinically, histologically, and roentgenologically.

e. Metastatic new-growths, cancer, hypernephroma, etc. A hopeless class.

f. Multiple myeloma with or without albuminosuria.

g. Tumors of tissues which normally occur in bone as well as in other parts of the body, such as nerves, vessels, and fat. These are fortunately rare for histologically they make great confusion by causing secondary bone destruction and proliferation.

h. Tumors too common and well understood to include, e.g. chondroma and osteoma and lesions of syphilis and tuberculosis.

i. Tumors too rare and little understood by even pathologists, for the surgeon to take them into practical consideration, e.g. the tumors of the specific marrow cells.

5. Differential diagnosis. A differential diagnosis is essential for proper treatment. Any of these tumors may be the cause of a pathological fracture. Such diagnosis is largely histological but there are many clinical and roentgenologic points which Bloodgood has ably set forth. To amputate the leg unnecessarily for a giant-cell tumor is almost worse than to procrastinate in a case of true sarcoma, for the results after early amputation in the latter are not very encouraging. Formerly I felt so hopeless in regard to amputation, that I was lukewarm about even exploratory incision. The registry has, however, found enough cured cases of the malignant type to convince me that amputation may be worth while, and I now feel that exploratory incision should be the rule, not only in cases of pathological fractures but in any bone tumor. My association with Dr. Ewing and Dr. Bloodgood has made me feel that in the majority of cases, with proper sections, clinical history, and X-rays, an expert pathologist can make a differential diagnosis. They will admit that a few borderline cases puzzle them. It is in such cases that radium seems most applicable, for it apparently benefits benign cases and retards malignant ones.

6. Prognosis. With the exception of those caused by new-growths it is a rule that pathological fractures tend to unite without much delay. Those due to carcinoma and other metastases rarely if ever do. Those due to osteitis fibrosa, cysts and giant-cell tumor, eventually unite, and a few cases due to sarcoma have been reported as uniting before death occurred. Two of these were metastatic sarcoma.

7. The treatment is the appropriate treatment of the lesion which has weakened the bone. Exploratory incision and expert pathological opinion are the first steps. It is not necessary to be very thorough in curetting the walls of cysts. Evacuating the contents, crumpling in the walls and realigning the bone is enough. If due to a giant-cell tumor, the wound should be opened widely and every bit of the current-jelly tissue removed. In malignant conditions, amputation will be wise even if metastases are already present, for these cases do not unite.

Without convincing histologic opinion, the experienced surgeon will not take off a limb when he finds a cystic cavity or red current-jelly tissue at the site of fracture; and he may amputate in spite of a negative report if he finds the soft tissues infiltrated with grayish, malignant-looking material. Where the fracture is the first or an early symptom, the assumption should be that the cause is benign.

In hopeless cases, where amputation has been refused, X-ray, radium, and Coley toxins may be tried, but the evidence collected thus far by the registry is not very favorable for any of these remedies in clearly malignant cases.

8. Prophylaxis. If we may judge by the material thus far accumulated by the registry, it should be a general rule to splint all cases of tumors of the long bones, as soon as they are observed. This applies particularly to tumors of the humerus and femur, which are not supported by a companion bone as are the ulna, radius, tibia, and fibula. Of 19 humerus cases, pathological fracture was

found in 47 per cent; of 102 femur cases in 15 per cent; of 79 cases of the four self-splinting bones in only 5 per cent. As a total it occurred in at least 14 per cent of the 200 supposed cases of sarcoma of the long bones so far reported to us.

I realize that this figure is inaccurate but I believe it is conservative, for in many of the cases included we have only a meager clinical history and no X-rays. The X-ray often reveals an unsuspected fracture. Then too, fractures will occur in more of the cases after they are reported to us, in their terminal stages. I say supposed sarcomata for we are finding on analysis that very often a sarcoma is not a sarcoma at all. But if 14 per cent of *supposed* sarcomata fracture from slight causes the rule applies to supposed sarcomata at least.

I know that Ewing has long felt that every sarcoma of a long bone should be splinted and kept in bed, on account of the danger of metastases. Yet I do not think that surgeons have made this a general rule, nor do I find it in the literature.

9. Theory. The subject we are discussing may be construed to include the question of whether fracture ever causes sarcoma. The literature contains many articles discussing this proposition, and great names may be found on both sides. Fracture in a healthy bone calls forth the repair process we know as callus. We know that callus may be exuberant and histologically resemble sarcoma, confusing our best microscopists. Suppose that the repair process starts and does not stop. Would this be malignancy? The definition of malignancy given by most pathologists is: "a new formation of cells which proliferate continuously and without control." Malignancy may be only an unbridled repair process and not the result of a stimulant emitted by bacteria, protozoa, or parasites. We have been looking for a positive cause. May not the cause be negative as by the removal of an inhibition? Without the fibrin ferment we bleed to death. Perhaps without the repair-checking ferment we repair to death?

10. Research. In closing a review like this, which is supposed to cover what we know of the subject, may it not be well to suggest what we want to know? At present these so-called giant-cell tumors particularly are occupying the attention of pathologists. May they not be due to rupture of nutrient vessels by fissure fractures? Suppose that the ruptured nutrient artery bleeds in the spongy bone as the temporal artery bleeds in some cases of fissure-fracture of the skull. A pulsating hæmatoma within the bone forms. This is followed by pulsating granulation tissue, which by pressure destroys the trabeculæ. Intraosseous "proud flesh" is formed and new bone cannot compete with its pressure. Will someone produce these tumors experimentally with fissure fractures or by trephining small holes and suturing large arteries in them? Cysts may be one stage of such lesions.

In closing let me remind you of the existence of the Registry of Bone Sarcoma and the need it has for the record of every case that comes to the knowledge of any member of this audience.

UNUSUALLY HIGH DEGREE OF LEUCOCYTOSIS FOLLOWING SPLENECTOMY FOR BANTI'S DISEASE

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THE following report is submitted because of the unusual degree of leucocytosis following splenectomy for Banti's disease which persisted for at least two months after operation without evidence of infection. Prince in the *Journal of the American Medical Association*, 1915, reports a postoperative leucocytosis reaching 37,700 on the twenty-second day after the removal of the spleen for splenic anæmia, which subsided to 10,000 on the thirty-fourth day; and as second case in which the spleen showed a chronic splenitis plus a typhoid abscess with a white count of 25,800 on the third day and 14,000 on the fourteenth day. Both these cases were without evidence of postoperative infection. A moderate degree of leucocytosis, from 11,000 to 13,000 appears to be the rule. No counts comparable to those here recorded, have been met with in the course of our reading, and they occasioned considerable alarm. Except for the elevation of temperature recorded there was no indication of infection, and the long period of time during which the patient was under observation makes it reasonable to suppose that any infective condition sufficient to cause such a leucocytosis would have made itself manifest.

R. S., male, white, single, age 49, entered the John Sealy Hospital, February 24, 1920; dismissed July 23, 1920.

The father died at the age of 63, of Bright's disease. The mother is living and well, aged 83. Two brothers are living and well. There is no history of tuberculosis or cancer.

Patient had measles at the age of 6 months; no other diseases of childhood. At 25 years of age he had ulcers of the throat and spat blood; he was treated in various ways for 1 year, and was finally cured by cauterization of the ulcers. Eight years ago he had a severe cough, lost some weight, but had no hæmoptysis nor other indication of tuberculosis, and recovered completely in a few months. He had influenza in 1918; no complications. Two years ago all his teeth were removed for pyorrhœa. He denies venereal infection.

Patient came under the care of Dr. James E. Thompson, February 24, 1920, complaining of weakness and loss of appetite, and enlargement of the spleen. His illness began about 3 years ago; he became pale, lost his appetite and had occasional attacks of vomiting. A few months after the onset of his symptoms, he consulted a physician who found enlargement of the spleen. When his attention was called to it, the patient found that he could detect the tumor himself. Since that time he has used numerous "tonics" but the loss of strength and weight have been progressive, and the tumor has steadily increased in size. Lately there have been no vomiting attacks; there has never been hæmatemesis.

Physical examination. Patient had been well developed physically but showed extreme emaciation and muscular weakness. The skin over the whole body had a brownish discloration, much like sun tan; across the upper part of the abdomen and the chest there were a few areas which were free from pigment and these contrasted strongly with the dark color of the remainder of the skin. There was no eruption nor roughness in the discolored areas. There was no jaundice either in the skin or conjuctivæ; mouth was edentulous, tongue coated, slight pharyngitis was present. Lungs were normal to percussion and auscultation. The heart was normal in size; soft systolic murmur.

Chest X-ray and sputum examinations were made because of a hacking cough which appeared a few days after patient was admitted to hospital, and was somewhat troublesome. The symptoms were those of an ordinary cold and no chest signs were present, and the cough finally disappeared. Sputum March 7 was negative for tubercle bacilli; but show a few influenza bacilli and a fair number of pneumococci. X-ray report by Dr. A. S. Holley, March 8: "Heart somewhat larger than normal, diaphragm a little higher than normal, right first rib bifurcates to form first and second ribs. Chest shows no abnormal markings."

A large tumor is found occupying the left side, extending downward to the brim of the pelvis, and a handsbreadth across the middle line. The tumor is firm, smooth, not notched on the edge. No pain is elicited on pressure. The liver is not palpable below the costal margin. The abdomen is otherwise negative. February 27 X-ray report on the stomach showed: "stomach very much distorted, oblong in shape and somewhat transverse in position." The extremities were negative except for a slight swelling of the ankles. The nervous system was negative; the genito-urinary system negative; urine negative.

SUMMARY OF BLOOD EXAMINATIONS

BEFORE OPERATION

Date	Hemoglobin Per cent	Red	Color Index	White	Polymorphonuclears Per cent	Lymphocytes Per cent	Large mononuclears Per cent	Transitionals Per cent	Eosinophiles Per cent	Basophiles Per cent	Anisocytosis	Poikilocytosis	Polychromatophilia	Nucleated reds
2–25	[illegible]	[illegible]	0.7	5,000	[illegible]	40	6	[illegible]	[illegible]	[illegible]	Marked	Marked	Present	0
3–7	[illegible]	[illegible]	0.8	9,300	66	32	7	[illegible]	[illegible]	[illegible]	Slight	Slight	Some	Fair no.
[illegible]	48	2,864,000	0.85	[illegible]	66	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Some	Slight	[illegible]
[illegible]	[illegible]	3,322,000	0.75	6,800	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	All examinations for malaria neg.			
[illegible]	[illegible]	[illegible]	0.8	7,200	68	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	3,312,000	0.68	7,000	47	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	45	3,776,000	0.6	6,000	[illegible]	20	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	3,360,000	0.9	7,000	[illegible]	[illegible]	4	15	[illegible]	[illegible]				

AFTER SPLENECTOMY MAY 16, 1920

5–20	90	4,508,000	1	11,500	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	Present	[illegible]	[illegible]	[illegible]
5–27	80	4,024,000	1.	19,600	70	[illegible]	2	[illegible]	1	1	[illegible]	[illegible]	[illegible]	[illegible]
5–31	Malaria	examination negative.												
6–3	76	3,288,000	1.2	35,400	67	[illegible]	[illegible]	[illegible]	1	2	Some	Some	[illegible]	Malaria neg.
6–10	53	3,824,000	0.6	31,400	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6–26	56	3,225,000	0.8	28,700	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7–10	72	2,880,000	0.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Slight	Slight	[illegible]	[illegible]

The pulse rate was 80 to 90; blood pressure 120 systolic; 80 diastolic. Blood examination on day after admission to hospital showed 1,900,000 red cells, 27 per cent hæmaglobin; color index 0.7; white cells 5,000. Differential count of leucocytes 49 per cent polymorphonuclears; 40 per cent lymphocytes; 6 per cent large mononuclears; 3 per cent transitionals; 2 per cent basophiles. The smears showed marked aniso-and poikilocytosis some polychromatophilia, but no nucleated red cells. For comparison the blood examinations both pre-operative and postoperative are tabulated at the end. A diagnosis of splenic anæmia, probably Banti's disease, was made, and as the patient was not in condition to stand operation immediately, Dr. M. L. Graves was asked to take charge of the medical treatment. Dr. Graves treated patient with daily doses of Blaud's pills, sodium cacodyl., strychnine, and later cod liver oil. Early in April he added extract of red bone marrow to this. Improvement was slow but fairly steady, but the tumor showed no change in size. There was still no increase in the size of the liver. Patient was regaining strength and a little weight, but was still much emaciated. For the first month, as shown in the table, the blood picture improved rapidly but after that time it remained practically stationary, and as there was no hope of further improvement under medical treatment alone, operation was determined upon. Operation May 16, 1920. Ether by Dr. Cariker. Patient took anæsthetic well. A median incision was used. The spleen was very large, firmly adherent to the tail of the pancreas, colon and omentum, but not to the parietes. Splenectomy was done without great difficulty and with almost no loss of blood, the pedicle being tied with double chromic ligature, as were the bands of adhesions which were all very vascular. The incision was closed with chromic mattress sutures in its upper part and continuous chromic stitches in the lower part, with silkworm-gut tension and skin stitches. No drainage was used. Respiration was shallow and rapid during delivery of tumor but after that satisfactory and at the close there was no shock. The examination of the liver was cursory, as it seemed advisable not to be overlong in the operation. No abnormality was noted. Convalescence: No shock occurred after the operation and the first few days were without complications of any kind. The healing of the wound was perfect, the superficial stitches were removed on the eighth day and the deep tension stitches on the tenth day. The temperature went up to 100° on the first and 101.4° on the second day and then for three days did not go above 99°. Blood examination was made as a matter of interest on the fourth day and showed 11,000 white cells. (See table.) On May 22, the temperature went to 100.2° and for the next few days ran from 98.6° to 100.4°. The leucocytes count, May 27, was 19,600, and a careful search for possible complications was made but without finding anything to indicate infection. On May 29 the temperature reached 104.2°, but came down promptly after an enema. From this date until June 9, it ran between 97.8° and 101°, with no evidences of trouble except that a moderate enlargement of the liver made its appearance June 3 and rather rapidly increased in size. On June 9, the temperature went to 105°, and for the next 3 days remained between 100° and 104°. Throughout this period, the patient experienced no discomfort; the pulse ran between 80° and 108°, the respiration was quiet and regular, 24 to 28; there was no sign, in the general aspect, of serious illness. When the temperature was high, there was a slight headache but no chills, sweating, nor prostration. The leucocyte count was alarming; on May 31 it reached 35,400; on June 3 it had dropped to 31,400, and on June 10 was 28,700. In view of this and of the very rapid increase in the size of the liver, a possible liver abscess was considered. On June 12, the liver was aspirated in three places but nothing was withdrawn except a

few drops of bloody fluid which were thought to come from the abdominal cavity. The liver now extended to a hand's breadth below the costal margin, and was slightly tender to pressure but the abdominal muscles were relaxed. Slight distention was present but this was readily relieved by enemata. June 12 to 16, the temperature ran from 99° in the morning to 103°, the highest daily temperature being reached at 9:00 or 10:00 p.m. On June 16, the liver was again aspirated without result. From this date the temperature began to subside and was afebrile by June 23. After that date until his discharge from the hospital June 23, there was an occasional elevation to 99°, but nothing higher. About June 15 medicinal treatment, such as had been used before the operation was again instituted and there appeared to be some increase in strength and improvement in the general condition. As will be seen from the table there was not any improvement in the red cells, which were at a maximum the fourth day after operation and then gradually fell to a count lower than the last pre-operative count. There appeared to be a slight decrease in the size of the liver during the last week of the patient's stay in hospital and the tenderness over it disappeared completely. It should be mentioned that there was no evidence of ascites during the convalescent period nor was there any icterus, as evidenced by coloring of the conjunctivæ. The complete tabulation of the blood examination before and after operation is shown in table.

Pathological report on the spleen. Weight 5 pounds 9 ounces as removed, without preservation. The capsule was somewhat thick but not markedly so; smooth except for bands of adhesions near the hilus where the colon and pancreas had been bound to it. The cut surface was deep red, soft, not diffluent, not very bloody. It has much the appearance of normal splenic pulp except that the splenic corpuscles are obscured. Microscopic sections taken from the surface and from the depths of the organ have identically the same structure. There is a fair amount of hæmatogenous pigment, but this is not a noticeable feature. There is slight increase in the thickness of the fibrous trabeculæ and capsule, and the fibrous trabeculæ are rather closer together than is usual, so that there is a slight relative and a very marked absolute increase in the amount of fibrous tissue present. There is an increased number of polykaryocytes so that there is no low field that does not contain one or more of these cells and they are larger than normal and vary considerably in size. Many have the character of foreign body giant cells. Many, especially the larger, contain more nuclei than are normal and numerous mitotic figures, but these are not atypical. These polykaryocytes tend to be arranged in groups. There is a loss of contour of the splenic corpuscles, which tend to be less sharply defined from the pulp than normally, but the central artery is preserved and the corpuscles are, as a rule, easily recognized. They tend to be elongated along the length of the artery in a somewhat spindle form and the ends of the spindle tend to merge into one another. There is a slight increase in the endothelium and some desquamation of swollen endothelium. There is an increased number of normoblasts but no abnormal varieties of nucleated red cells. The red corpuscles throughout are greatly decreased and the small blood vessels contain very little blood (this despite the fact that the main vessels were ligated before the tumor was preserved and section not made until after fixation.) Throughout the entire structure are many mast cells and fibroblasts and these tend to lie adjacent to the interlacing network of fibrous trabeculæ.

Pathological diagnosis: chronic splenitis, Banti type, early stage.

After history: A report from this patient about November, 1920, states that he was feeling better and was having no discomfort, but did not regain strength. No further direct report was received, but a notice of his death appeared December 11, 1920. No details could be obtained.

PENETRATING ABDOMINAL WOUNDS

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AUTHORS are too prone to publish their good results and to forget their failures. If progress is to be made in medicine failures should be recorded as well, for by this means alone will the statisticians be able to estimate properly the status of the subject under consideration. With this object in view I have undertaken to collect and collate the abdominal penetrating wounds which have been observed in the various surgical services in the University Hospital, Baltimore. Whether or no there be any visceral lesion when the missile has passed through the peritoneum, as far as this paper is concerned, the lesion is classed as a penetrating wound If in addition, during its course, a hollow or solid viscus be injured, the term perforating is employed, even though the most recent authorities restrict this designation more commonly to those injuries only involving the entire thickness of the wall of a hollow viscus If this classification be accepted, trauma of the solid organ is spoken of as incised, lacerated, punctured, etc. The purpose of this contribution is to emphasize the importance of a thorough abdominal exploration when in doubt as to whether the peritoneal cavity has been entered or not. In all bullet wounds, no matter how remote the point of entrance, when abdominal symptoms arise the abdominal viscera should be inspected. If no damage to the intra-abdominal structures has been done, the patient has only been put to a temporary inconvenience; whereas if a hollow viscus be injured a life may be saved which otherwise would have been sacrificed. A laparotomy is called for with especial force, if the wound is located in the lower chest or far down in the abdomen. The results obtained in this class of cases in a large metropolitan hospital should be of interest to the profession.

Case 1. A. K., a colored female, of Baltimore, age 30, housework, was admitted to the University Hospital, May 20, 1917, at 10 a.m., for a gunshot wound of the abdomen incurred an hour earlier. When brought to the hospital she was much shocked, so was immediately stimulated. Examination revealed a bullet wound in the right side of the abdomen several inches from the midline and on a level with the umbilicus. Her abdomen was markedly distended and tender to the touch. The belly wall was rigid throughout. In addition there was a second bullet hole in the right buttock and she was bleeding from the vagina. The temperature was 96° F., pulse 68, respiration 20.

Operation, May 20, 1917, ether anæsthesia. iodine technique—enterorrhaphy, resection of ileum, end-to-end anastamosis—died.

The abdomen was opened through a mid-line incision. On entering the peritoneal cavity, it was found filled with free blood. This was mopped out. Further search revealed twelve holes in the ileum and eight in the mesentery. Nine of the holes in the intestine and the eight in the mesentery were closed with fine silk sutures. Three of the holes in the small gut were so close together and the bowel so badly torn that 3 inches of the intestine had to be resected. The continuity of the intestinal canal was restored by means of a Murphy button end-to-end anastomosis. The patient was now very much shocked so the operation was concluded by the insertion of two rubber tubes and four cigarette drains into the pelvic basin and the abdominal wall closed in tiers down to the drains. The woman did very well until June 14, 1917, when she began to vomit frequently and persistently. She lost ground steadily, and daily became weaker and weaker. Though assiduously stimulated she failed to rally and died June 28, 1917.

The Murphy button was passed June 14, 1917, From operation to date of death temperature was never normal, both night and morning indicating that there was some absorption going on. The temperature oscillated between normal and 104, the pulse 90 and 160, the respiration 20 and 40. Death was attributed to (1) bronchopneumonia, (2) toxæmia, (3) exhaustion.

Case 2. E. O., colored, female of Baltimore; laundress; age 33, was admitted to the University Hospital, September 11, 1917, with the complaint of a gunshot wound of the abdomen. She stated that while walking in the street she was shot by a man from the opposite side of the street. The accident occurred about 2 p.m. and she was rushed by the police patrol to the hospital. On admission she was suffering considerable abdominal pain. The abdomen was exquisitely tender throughout and the abdominal muscles were tense and rigid. The wound of entrance was on the left thigh immediately above the great trochanter and a little to its outer side. The bullet finally came to rest in the right iliac region just beneath the skin, so must have

coursed through the abdominal cavity transversely and slightly upward.

Operation, September 11, 1917, 3 p.m., ether anæsthesia, iodine technique—suture of perforated ileum and drainage of urinary bladder—recovered.

The abdominal viscera were approached by a left rectus incision. On opening the peritoneum, a small amount of bloody fluid was found in the abdominal cavity. This was mopped out with sponges. Investigation of the alimentary canal revealed two perforations in the ileum. These were closed with intestinal silk. Further search demonstrated a hole in the urinary bladder. A rubber tube was inserted into the rent, and the bladder sutured around it. As the remainder of the abdominal contents were found to be uninjured, the operation was concluded by placing two cigarette drains to the pelvic floor and closing the abdominal wall in layers up to the point of emergence of the drains. With the exception of the development of an abscess in the left buttock which was incised and drained September 17, the woman made an uneventful recovery. She was discharged October 17, 1917, cured. Her bowels were moving regularly and she voided urine without trouble.

Case 3. W. S., colored; male, of Maryland; age 35; laborer; was admitted to the University Hospital, September 30, 1917, for a gunshot wound of the abdomen. He was shot about 4 p.m. and received at the hospital around 7 p.m. He was in fair condition. The bullet entered the back over the right kidney and ranged forward and upward as indicated by the point of exit a little below and to the outer side of the right nipple. The temperature was 97°, pulse 80, respiration 24. The abdominal wall was quite rigid and tender throughout. It was evident that the peritoneal cavity had been penetrated, so operation was advised and accepted.

Operation, September 30, 1917, 8 p.m., ether anæsthesia, iodine technique—laparotomy and drainage —recovered.

The abdomen was entered by means of a right rectus incision. On opening the peritoneum, a small amount of free blood was found among the coils of the intestines. This was mopped out. Inspection of the liver revealed a perforating hole through the central portion of the right lobe, the ball having passed through the upper pole of the right kidney before entering the peritoneal cavity. So drains were placed in the right renal fossa and in the hole in the liver and the wound closed in the usual way. The patient was then placed on his left side, iodinized and properly draped and an incision extending from the last rib above downward to the crest of the ilium, thereby exposing the kidney. This disclosed a large hole in the upper pole of the kidney and a considerable amount of blood clot in the perirenal structures. After wiping out the blood, drainage was placed down to the wound in the kidney and the rest of the wound closed. In order to guard against lock-jaw a prophylactic administration of antitetanic serum was administered before the patient was returned to the ward. He stood the operation well and was returned to his bed in very good condition. The postoperative course was extremely smooth and the patient left the hospital November 11, 1917. The wound in his back was entirely healed, the one in front discharging but slightly. He was in good condition and pronounced recovered.

Case 4. J. K., colored; male; of Baltimore, age 24; stevedore; was admitted to the University Hospital, at 1 p.m., November 10, 1918, with the history of having been shot an hour earlier, in the abdomen.

When he was received in the hospital he evidenced signs of acute internal hæmorrhage. The wound of entrance was a little above the umbilicus and to the left of the mid-line. The abdominal muscles were rigid throughout and very tender to the touch. He was pale and in a state of collapse.

Operation, November 10, 1918, 2 p.m., ether anæsthesia, iodine technique—suture of the small intestine, colon, and mesentery—died.

The patient was on the operating table within an hour after admission to the hospital. The abdominal cavity was approached through a right rectus incision. On opening the peritoneum, a large quantity of blood escaped. This was found to be issuing from an injured vessel in the mesentery of the small intestine which was still actively bleeding. This hæmorrhage was controlled by introduction of a mattress suture of intestinal silk. The peritoneal cavity was then mopped dry and a further search instituted for other damage. This investigation revealed the presence of five perforations in the jejunum and two in the transverse colon, which holes were closed with fine silk sutures. Other than the aforementioned, no further damage could be detected. A small incision was then made above the pubes, through which a rubber tube and a cigarette drain were inserted into the pelvis. Still another cigarette wick was introduced through the upper incision. This likewise terminated in the pelvis. The abdominal wall was closed with chromic catgut in tiers, a tract being left for the mergence of the drain. The patient was returned to the ward in fair condition. He did well until about 6:30 p.m., then went into collapse, from which he did not react, and died at 9 p.m., November 10, 1918.

Case 5. B. S., white; female; age 8, school-girl was admitted to the University Hospital, December 15, 1918, with the history of having been shot in the stomach by her little brother. She was lying on a couch, all covered up and her brother not knowing that she was there discharged a cat and rat rifle at the couch inflicting a wound in his sister's abdomen. She was brought immediately to the hospital arriving that afternoon 2 hours after the accident. Examination revealed a bullet wound in the abdomen about an inch from, and to the left of, the median line. There was no evidence of external hæmorrhage. The patient was pale, and her pulse was rapid. The abdominal muscles especially in the upper segment were rigid and very tender to the touch.

Operation, December 15, 1918, 7 p.m., ether anæsthesia, iodine technique—laparotomy and drainage—recovered.

The abdominal cavity was reached by a right rectus incision. On opening the peritoneal cavity it was seen that the bullet had furrowed the anterior surface of the liver and lacerated Glisson's capsule. The trough was not deep and there was but little oozing. In passing the hand over the upper surface of the liver, a 22 caliber bullet covered with particles of clothing, was recovered. The other viscera were found to be uninjured. Therefore, a small stab wound was made close above the pubes through which a rubber tube was carried into the pelvic basin. Through the original wound a tube was placed in the subhepatic space and a cigarette wick on the anterior surface of the liver. This wound was then closed with the exception of the drainage tract. The patient was returned to the ward in fair condition and made a smooth and unruffled recovery, being discharged cured, January 4, 1919.

Case 6. R. B., white; male, age 26; clerk; was admitted to the University Hospital, February 2, 1919, with the complaint of a gunshot wound of the abdomen. He sought relief for a bullet wound accidentally received at 2 a.m. while standing on the sidewalk at Baltimore and Pine streets. The wound of entrance was in the sixth intercostal space in front. There was no wound of exit. His appearance indicated internal hæmorrhage. The temperature was 99°, pulse 98, respiration 34. He was restless. The abdominal wall was rigid especially in its upper portion. It was thought that he had a bullet wound of the liver and perhaps of the pleura and lungs as on sponging the external wound little bubbles of air were mixed with the escaping blood.

Operation, February 2, 1919, 4 a.m., ether anæsthesia, iodine technique—incision and drainage—died.

The abdominal cavity was reached through a high right rectus incision. When the peritoneum was opened a large quantity of free blood was seen lying between the coils of the intestines. This was cleaned out. On inserting the hand between the ribs and the dome of the liver, a lacerated wound was felt in the anterior surface of the liver. The damage was high up and quite inaccessible. A hole was also located penetrating the diaphragm. On account of the position of the wound it was considered inadvisable to prolong the operation in an attempt at suture, the accomplishment of which would require rib resection, so a cigarette drain was introduced to the hole in the diaphragm, in its journey coursing between the liver and the ribs. Additional drains were placed in the subhepatic space. A small incision was then made above the pubes, and a rubber tube carried into the pelvis. The abdominal wall was closed in tiers. Patient returned to ward in fair condition. Bullet not found; probably lodged in the liver.

February 3, 1919. Since operation the patient has gotten progressively worse. The pulse has become weaker and weaker. His abdominal cavity is draining freely, for the most part, serum. In spite of stimulants and supportive treatment he died. No cause for the death was discovered.

Case 7. L. K., white; male; age 19, no occupation; was brought to the University Hospital, February 12, 1919 with the history of having been shot in the back. There was a bullet wound in the right side of the back from which a small amount of blood was escaping. Anteriorly in the sixth interspace on the right side a foreign body could be palpated beneath the skin. The patient's abdomen was rigid and tender. The symtoms indicated internal hæmorrhage.

Operation, February 12, 1919, ether anæsthesia, iodine technique—exploratory laparotomy, drainage—cured.

He was taken to the operating clinic within 2 hours after the injury, and the abdomen entered by a high right rectus incision. On opening the peritoneum a large quantity of blood escaped. No wounds could be seen in the stomach or intestines, but on the anterior surface of the liver high up under the diaphragm was a bullet wound. Owing to the inaccessibility of the wound and the patient not being in very good condition, no attempt was made to suture the laceration. A cigarette drain was placed immediately over the opening in the liver, a rubber tube and several cigarette wicks in the subhepatic space, and a small tube in the pelvis through a counter incision above the pubes. The abdominal incision was closed to drains, and patient returned to bed in fair condition.

March 4, since the operation the patient has been running a more or less irregular course, the rises and falls in temperature giving one the impression of the presence of suppuration. The abdominal incision is draining pus freely. Examination of the chest shows marked dullness on the right side and fluid is suspected. An aspirating needle was inserted but no fluid obtained. The patient continued to run an irregular temperature until March 15, when the aspirating needle was again inserted in the right side of the chest, where there were suggestions of a collection of fluid, and a small quantity of clear fluid was obtained. From that time the patient improved slowly but steadily and was discharged from the hospital, April 6, 1919, cured.

Case 8. R. T., colored; male; 17; laborer; of Baltimore; was shot at 7 p.m., October 19, 1919, and admitted to the University Hospital at 9 p.m. The injury was accidental and caused by a 32 cal. pistol ball. The missile entered the right side of the abdomen coming from a pistol in the hands of a man to the right and slightly to the rear of the patient. Operation October 19, 1919, ether anæsthesia, iodine technique—enterorrhaphy—pneumonia, cured.

The abdomen was entered through an incision along the right linea semilunaris. An injured area was found on the transverse colon but probably it did not perforate the bowel. The small intestine was also injured in two places without perforation. All three of the weak spots were sutured as precautionary measures against future rupture. No other damage could be found. There was no free

blood in the peritoneal cavity. The abdominal wall was closed with catgut without drainage. At the close of the operation, the patient was in good condition. One thousand five hundred units of antitetanic serum was administered. Although this would have seemed a most favorable case for a rapid and speedy recovery, the man developed a frank penumonia of the lower lobe of the left side. This complication ran a typical course and had cleared up by October 29. The man was becoming impatient and refused to remain in the hospital any longer so was discharged November 2, 1919. The temperature was normal, the incision entirely healed and chest negative. A fluoroscopic examination located the bullet lodged in the posterior part of his pelvis on the left side.

Case 9. H. R. B., white, male; age 16; painter; of Maryland, entered the University Hospital, Baltimore, November 13, 1919, at 4 p.m., for gunshot wound of the abdomen. He gave a history of having been shot in the abdomen 2 hours earlier. He said he had been resting on a stump with the muzzle of a shotgun against his abdomen, when on arising in some mysterious way the load was discharged. He was in profound shock, pulse rapid, 140 to the minute, the respirations were sighing and thoracic in character. The abdominal muscles were very tender and he resisted all attempts at palpation. The abdomen was not distended. To the right of the mid-line and just below the umbilicus was a wound which was somewhat larger than a silver dollar.

Operation, November 13, 1919, iodine technique, ether anæsthesia—enterorrhaphy—died.

A right rectus incision was made between the wound and the median line for the purpose of exploration. When the peritoneal cavity was opened a large quantity of blood escaped and hissing of air was heard. The large intestine was inspected and four perforations found; two in the transverse and two in the upper part of the ascending colon. These perforations were closed. The small intestine showed no evidence of injury. Further investigation developed a wound in the liver sufficiently large to admit a small-sized fist. Pieces of clothing and gun-wadding were felt in the depths of the hole. These were extracted. As the boy's condition was precarious, no attempt was made to suture this wound which was large and ugly; instead the rent was stuffed with gauze. Other drainage was placed in the subhepatic space, and the pelvis and the wound closed down to the drainage track. The patient was returned to bed in a badly shocked condition and no hope for cure. He died at 6:40 p.m.

Case 10. W. G., male; colored; age 29, chauffeur; of Baltimore, was wheeled into the ward at 10 a.m., November 28, 1919, with a gunshot wound of the abdomen. He was shot about 7:30 a.m., by a man with whom he had no acquaintance, because of the refusal of the loan of some money. Examination showed a penetrating gunshot wound in the right upper abdomen, below the eleventh rib. The patient was in much pain and his abdomen in its entire extent was very tender and rigid. The wound of entrance was anterior and just below the costal margin. The abdomen was moderately distended. Neither pulse nor appearance suggested internal hæmorrhage. He could give no clear statement concerning the direction of the bullet. No bile escaped from the wound. The impression was penetrating wound of the abdomen with probable injury to the ascending colon from gunshot wound.

Operation, November 28, 1919, ether anæsthesia, iodine technique—exploratory laparotomy, no drainage—cured.

The abdomen was entered by a right rectus incision somewhat to the inner side of the wound of entrance. There was a contusion of the anterior wall of the stomach in the neighborhood of the pylorus, but apparently no penetration. The liver was wounded in two places in its margin. No further damage was found. The bullet evidently left the peritoneal cavity through the suspensory ligament of the liver. No hæmorrhage was present. No drains were used, but the abdomen was closed tight. The postoperative course of the patient was smooth. He made a good recovery and was discharged from the hospital December 12, 1919.

Case 11. C. S.; colored; female, housewife; age 21, of Baltimore, was admitted to the University Hospital, around 1 a.m. January 19, 1920, for a pistol wound of the abdomen received an hour earlier. The pain in her abdomen was so intense as to cause her to cry out. She was intensely shocked from bleeding into her peritoneal cavity. The abdomen was distended, tense, boardlike, tympanitic in front but dull in the flanks. It was tender throughout. There was a small wound of entrance in the lower right quadrant. A catheterized specimen of urine showed no blood.

Operation, January 19, 1920, 3 a.m., ether anæsthesia, iodine technique—enterorrhaphy—died.

The abdominal cavity was entered through the right rectus route. When the peritoneum was opened about 1,200 cubic centimeters of free blood, including some large clots, was found in the abdominal cavity. The chief source of the bleeding was a torn vessel in the mesentery of the ileum. This was arrested by a silk suture and the belly mopped clean. Besides this damage there were ten perforations in the ileum from which fæcal matter was oozing and soiling the peritoneum. These varied in diameter from $\frac{1}{8}$ to $\frac{3}{8}$ of an inch. All of the holes were closed by mattress sutures reinforced by a row of interrupted silk sutures. As far as could be determined no further damage had been done the small intestine. The cæcum, sigmoid, and rectum were undamaged. The bullet was not located. After the introduction of ample drainage, both into the general peritoneal and pelvic cavities, the abdomen was closed down to the drains. As the patient was in very poor shape at the conclusion of the operation, an incision was made down to the median basilic vein and 600 cubic centimeters of

normal salt solution introduced into the circulation. Though actively stimulated, the woman's condition became worse after the operation and she gradually sank without reacting and died at 2 a.m., January, 20, 1920.

Case 12. W. S., white; male; age 19; ex U. S. marine; shot himself about 6 p.m., March 9, 1920 He was admitted to the University Hospital the same evening at 7 p.m. Examination revealed a bullet wound in the left side of the thorax in the seventh interspace and a half inch to the inner side of the nipple line. The bullet lodged in the muscles of the back behind the lower ribs where it could be felt. The abdomen was rigid, especially in the upper quadrant. It was distended and somewhat tender to pressure. During the examination the patient vomited a small quantity of blood mixed with stomach contents. The breathing was distinctly thoracic. There were no symptoms of lung injury. Obviously his stomach had been perforated. He was in good condition. His pulse was fair and he was not greatly shocked. There were no signs of internal hæmorrhage.

Operation, March 9, 1920, 9 p.m., ether anæsthesia, iodine technique — gastrorrhaphy—pneumonia, cured.

On opening the peritoneal cavity, some free blood was detected. This was found to be issuing from a perforating wound in the left lobe of the liver, the wound of entrance was sutured, that of emergence on the under surface of the organ was packed with gauze. Examination of the anterior wall of the stomach revealed a hole located about 2 inches from the pylorus and near the lesser curvature. This was closed by a purse-string suture which was reinforced by a line of Lemberts. Further search revealed, to the left of the œsophagus, a hole in the diaphragm through which air was being aspirated into the thoracic cavity. This hole was sealed by interrupted sutures of fine silk. The stomach was then delivered, a hole made in the mesocolon, and the posterior wall of the stomach searched for injury. Here a perforation was detected in a location corresponding to the wound in the anterior wall. This was closed by two layers of interrupted sutures. The opening in the mesocolon was closed, and drainage of the lesser peritoneal cavity obtained through the gastrocolic omentum by rubber tubage. Fortunately for the patient he had not eaten since morning and there had been comparatively little seepage into either the general or lesser peritoneal cavity. There was no pus in the peritoneal cavity, but a plastic peritonitis had already set in. Though the boy was in fair condition, it was thought best not to prolong the operation by a search for the bullet. Convalescence was rather stormy, a bronchopneumonia supervened, and the abdominal wall suppurated, but the patient eventually threw off these infections and was discharged from the hospital 5 weeks after admission.

Case 13. J. M., white; male; age 71; farmer, of Maryland; was admitted to the University Hospital, March 20, 1920, about 2:30 p.m., in a semicomatose condition. He was brought in for relief of a gunshot wound of the abdomen received about 48 hours prior to entrance to the hospital. He was unable to answer questions intelligently but complained bitterly of pain. Two gunshot wounds were visible, one of entrance in the right upper quadrant and another in the left hypogastric region. He resented palpation. There was marked abdominal rigidity. The belly wall though hard was but slightly distended. Liver dullness was present. He did not vomit after admission to the hospital.

Operation, March 20, 1920, ether anæsthesia, iodine technique—exploratory laparotomy, drainage —died.

A laparotomy was made through the mid-line for the purpose of exploring the damage. The abdomen was full of bloody matter and the viscera in the upper right quadrant were tied up by many adhesions. A large hole was found in the hepatic flexure of the colon. Through the vent thus created fæcal material was freely pouring. As the intestine was too necrotic to suture and the patient in such a forlorn condition, a rubber tube was inserted in the aperture and the gut attached to the parietal peritoneum. This procedure, with free drainage of the peritoneal cavity, had to be relied upon to pull the man through. Tucks and tubes were placed in the upper abdomen and the right lumbar regions and additional drains in the pelvis through a suprapubic stab. The man failed to rally, however, and died March 21, 1920. Autopsy showed a bullet wound ½ inch below the cartilage of the seventh rib and 2½ inches to the right of the ensiform cartilage and a second bullet wound in the left lower quadrant. This wound did not enter the peritoneal cavity. There was an abundant exudate on and between the coils of the intestines. The death was attributed to a generalized peritonitis from a perforating gunshot wound of the ascending colon.

Case 14. E. B., colored; female; age 18; housework; sought the University Hospital, about 5 p.m., June 23, 1920, for relief of a gunshot wound of the right arm and abdomen. The wound in the right arm consisted in the point of entrance solely. The ball struck and shattered the humerus about the mid point. About halfway between the crest of the ilium and the last rib there was another hole, a little posterior to the mid-axillary line. On the opposite side of the abdomen, but slightly anterior to the mid-axillary line over the tenth rib, a similar opening could be seen. The woman was in a condition of shock, the abdomen boardlike and tender, and, as she was evidently bleeding internally, an exploratory laparotomy was suggested and accepted.

Operation, June 23, 1920, 6:30 p.m., ether anæsthesia, iodine technique—gastrorrhaphy—died.

The abdomen was opened slightly to the right of the mid-line through the sheath of the right rectus muscle. The abdominal cavity was found to contain a large quantity of free blood, especially about the right kidney fossa. A large, jagged opening was found in the peritoneum just at the outer border of

the right kidney. The bullet then entered the right lobe of the liver and followed a course from the left to the right and at a slight angle from behind forward. The wound in the liver was bleeding profusely. This was tightly packed with gauze, as the liver substance was too lacerated to suture. In its further course the ball perforated both walls of the stomach a slight distance from its lesser curvature and about the mid point. The openings in the stomach were closed, the one in the posterior wall being reached by an opening through the transverse mesocolon. The spleen, and both kidneys escaped injury. The entire intestinal tract was examined without the detection of any further damage. The pelvis was full of a sanguinous fluid. Some stomach contents also were found in the peritoneal cavity. The woman left the table in a condition of extreme shock and died about 10 p.m., June 23, 1920, without regaining consciousness.

Case 15. M. R., colored; male; age 32; chauffeur, of Baltimore; was brought to the University Hospital at 7:50 p.m., November 14, 1920, for a pistol wound of the abdomen. The wound of entrance was in the epigastrium about 1½ inches to the left of the mid-line, and somewhat above the level of the umbilicus. There was no point of exit, but the ball could be felt lying just above the anterior spine of the right ilium. He was in good condition. The pulse was 88. An hour later the pulse had run up to 104, and the abdomen had become quite rigid. After admission he vomited, but the vomitus contained no blood.

Operation, November 14, 1920, 9:40 p.m., ether anæsthesia, iodine technique, gastrorrhaphy, cured.

The abdomen was entered through a high right rectus incision. Upon opening the peritoneum a quantity of liquid blood escaped. Two perforations were found in the anterior wall of the stomach. These were sutured with fine silk. The other viscera were thoroughly examined, but no other damage was found. A rubber tube with exit through a suprapubic wound was placed in the pelvis and appropriate drainage in the subhepatic space in close proximity to the stomach. After closure of the wound the man was returned to the ward in good condition. He made an uneventful recovery, and was discharged cured December 26, 1920.

Case 16. J. D., colored; male; laborer; age 28; of Baltimore; was admitted to the hospital at 12:30 a.m., December 25, 1920, for a pistol wound of the upper abdomen received about a half hour earlier. The point of entrance was immediately below the right costal margin and about 2 inches from the mid-line. The bullet could be felt on the left side, just below the costal margin, about 6 inches from the mid-line. There was very little muscular rigidity, if any; no nausea or vomiting. The temperature was 98.6°, pulse 90, mentality clear, no signs of shock, slight pain. The general condition was good. It was thought at entrance that bullet had not penetrated peritoneal cavity but examination clearly indicated penetration and probable perforation of a viscus.

Operation, December 25, 1920, 12:30 a.m., ether anæsthesia, iodine technique — gastrorrhaphy — cured.

The abdomen was entered through a mid-line incision. On opening the peritoneum a small amount of bloody serum was seen in the upper abdomen among the coils of the viscera. Two perforations were found in the stomach near the greater curvature. The point of entrance of the bullet into the stomach was about 4 inches from the pylorus and to the left. It left the organ 4 inches farther to the left. It had evidently entered and passed out of the stomach in a straight line, and traveled from right to left. There was a slight amount of free blood in the abdominal cavity, but no intestinal contents had leaked through the hole. The perforations were closed with a double row of silk Lembert sutures. A tube drain was inserted into the left renal fossa and two cigarette drains were inserted through the abdominal wall to the right of perforations. The patient left the operating room in excellent condition. The convalescence was smooth but when an attempt was made to remove the rubber tube it was found to be firmly fixed; so on January 11, 1921, a left McBurney incision was made. A finger inserted through this opening could feel the tube caught in a mass of omentum, which had apparently twisted itself around the tube and gave to the mass a bulbous shape. The mass was straightened out by a finger in the abdomen and drawn into the wound. The tube was then easily extracted. The McBurney incision was closed without drainage. Discharged January 24, 1921, with all wounds healed except a small granulating area at site of drains.

Case 17. This patient, a colored man; H. D., age 34; single; laborer; was admitted to University Hospital, December 13, 1920, at 8 a.m., with the complaint of having been accidentally shot in the left side, at 8 p.m., the preceding night, by a friend who was cleaning a pistol. The bullet traveled about 4 feet before striking him. On admission to the hospital, 12 hours after the accident, he was in a state of collapse, his legs were drawn up, his facies was anxious, his pulse rapid collapsed, of poor volume and tension. His abdomen was rigid, painful and tender throughout, and dull on percussion. The hole of entrance was located in the upper left abdominal quadrant, 1 inch below the tenth costal margin in the mid-axillary line. No wound of exit could be seen anywhere. He voided his urine voluntarily, but passed nearly pure blood. The quantity was small. On admission his temperature was 97°, pulse 120, respiration 22. The clinical impression was (1) gunshot wound of the abdomen; (2) internal hæmorrhage; (3) perforations of the hollow viscera including the urinary bladder.

Operation, December 13, 1920, ether anæsthesia, iodine technique — enterorrhaphy — gas infection, died.

The peritoneal cavity was entered through a long left rectus incision. Upon opening the cavity a large quantity of blood was found and mopped out. No

active bleeding was detected, but five perforations of the small intestine, one of the mesentery and one into the urinary bladder, were found and closed. Drainage was obtained by two rubber tubes and four cigarette wicks. The abdominal incision was closed in tiers down to the drains. The man left the table in poor condition. He did not rally after being returned to bed and died suddenly at 8:40 a.m., December 15, 1920. The temperature varied between 97 and 101° F., pulse 90 and 130, respiration 20 and 45.

Autopsy: The body crepitated over both the upper and lower extremities. The usual incision from the suprasternal notch to the symphysis pubis revealed gas containing subcutaneous tissue. The epicardium contained gas beneath its structure. There were a few little gas bubbles seen at intervals in the liver. The urinary bladder showed a sutured wound. The small intestine a number of sutured perforations. The bullet was found lodged in the soft tissues in the neighborhood of the prostate. It was recovered.

Causes of death: (1) hæmorrhage; (2) acute suppurative peritonitis; (3) sepsis from gas infection due to pistol bullet. The bacillus aerogenes capsulatus was grown from the débris in the cavity of the heart.

Case 18. C. S., white; male; mechanic; aged 29; of Maryland; came to the University Hospital, June 1, 1921, with the complaint of a gunshot wound of the chest and abdomen. The point of entrance of the missile was above the right seventh rib, the point of exit on the same level just posterior to the posterior axillary line. The man was somewhat shocked and suffering some pain. His respirations were jerky, catchy, and rapid. The abdominal muscles were very rigid. There was no evidence of pneumothorax, hæmothorax or marked intra-abdominal hæmorrhage. It was supposed that the bullet had traversed the costophrenic recess and passed through the diaphragm and liver, so exploratory incision was advised and accepted.

Operation, June 1, 1921, 8 p.m., ether anæsthesia, iodine technique—exploratory laparotomy, drainage—cured.

The injury was incurred about 4 p.m., so the patient was under operation about 4 hours after the wound was received. Access was gained to the peritoneal cavity through a high right rectus incision. It was found to contain no free blood. However the bullet had cut a gutter in the superior surface of the liver. No other abdominal viscera were injured. A rubber tube was placed in the wound in the liver and brought out through the track made by the bullet posteriorly. Two cigarette drains were placed through the operative wound; one in the renal fossa and one between the liver and the diaphragm. The man made an uneventful recovery and was discharged June 29, 1921, entirely well.

Case 19. G. W., colored, laborer; male; age 25; of Baltimore; was admitted to the University Hospital about 10 p.m., June 20, 1921, with a gunshot wound of the abdomen. The bullet entered the belly in the right lumbar region about 2 inches above the posterior superior spine. Pain, shock, the location of the wound and generalized abdominal tenderness left no choice other than an exploratory laparotomy.

Operation, June 20, 1921, 10:30 p.m., ether anæsthesia, iodine technique—suture of the liver, gastrorrhaphy—peritonitis, died.

Admittance to the abdominal viscera was obtained through a right rectus incision. About a pint of free blood was discovered in the pelvis and lesser amount in the lesser peritoneal cavity. A laceration in the right lobe of the liver was gaping and bleeding profusely. Suture of this wound checked the further escape of blood from the torn liver vessel. A wound 3 inches long in the anterior wall of the stomach in close proximity to the pylorus was closed by mattress sutures of silk, reinforced by a continuous Lembert. The entire intestinal track was traced for perforation but none found. Two rubber tubes were carried into the lesser peritoneal cavity, four cigarette drains in the upper right quadrant, and one tube and two cigarette wicks to the pelvis. Particles of food such as meat, peas, and potatoes were scattered throughout the peritoneal cavity. The detritus was cleaned out as well as possible. With the closure of the wound and the draping of the wound completed, the patient was returned to the ward in but fair condition.

The morning following the wound was draining freely, the drainage consisting to a large extent of bile. The abdomen was fairly rigid but not distended. No radial pulse could be found. The femorals were beating at the rate of 160 per minute. Though the patient was conscious, he was failing rapidly and died at 11 a.m., June 21, 1921. Autopsy revealed a hole in the under surface of the duodenum overlooked at operation, through which intestinal contents were leaking, and a coexistent peritonitis.

Case 20. A. S., white; female; age 28; housewife, of Baltimore; entered the University Hospital, January 3, 1921, suffering with a gunshot wound of the abdomen. The wound of entrance was at the edge of the costal margin on a level with a point 2 inches below the xiphoid process and to the right. The shooting occurred about 11 a.m. and the patient was admitted at noon. She was greatly shocked and complained of intense abdominal pain. A catheterized specimen of urine was clear. She vomited copiously but the ejecta contained no blood.

Operation, January 3, 1921, 1:30 p.m., ether anæsthesia, iodine technique—exploratory laparotomy, drainage, overlooked hole in the sigmoid, perforated liver and pancreas—pneumonia, peritonitis, died.

The peritoneum was opened through a right rectus incision extending from the chondral margin to the umbilicus. On incising the peritoneum a large amount of free blood and some clots were seen. These were limited mostly to the lesser peritoneal cavity. It was seen that the bullet had passed entirely through the right lobe of the liver. Bleeding

from this wound had ceased. There was also a hole in the lesser omentum and a perforation through the body of the pancreas. The wound in the latter organ was still actively bleeding. There was no evidence of injury to the retroperitoneal vessels, nor to the left ureter or kidney. The entire small intestine was eviscerated without result. A hole was found in the transverse mesocolon, but there was no bleeding at this point. No perforation could be found in either the transverse or descending colon. There was, however, considerable emphysema of the mesentery of the sigmoid, but no hæmorrhage from, nor injury to, the sigmoid could be demonstrated. Examination of the pelvic organs showed the uterus to be the size of a 3 months' pregnancy. After the institution of appropriate drainage and the closure of the wound with the exception of the path through which the drains emerged the patient was returned to her ward. She was only in fair condition. The patient did not do well and died at 1:25 a.m., January 7, 1921.

Autopsy revealed a pin hole in the under surface of the sigmoid through which liquid intestinal contents were escaping and a co-existing generalized peritonitis, and bronchopneumonia.

Case 21. G. L., colored, male; laborer; age 33; of Maryland; was brought to the University hospital about 8 p.m., April 9, 1921, with the history of having been shot in the abdomen at 5:30 p.m. Examination showed a bullet wound just below the costal margin and 4 inches from the mid-line on the left side. In the left side of the back just beneath the skin, between the ilium and ribs, the bullet was felt. The patient was unable to walk. He was suffering intense pain. The abdominal wall was very tense, rigid, and painful to touch throughout its entire extent.

Operation, April 9, 1921, ether anæsthesia, iodine technique—enterorrhaphy—died. The abdomen was entered through a left rectus incision. On opening the peritoneum, a moderate amount of blood escaped. The stomach was examined and found to be intact. Seven perforations were found in the ileum and one in the transverse colon near the splenic flexure. All of these holes were closed with fine silk. Examination of the entire intestinal tract failed to disclose any other damage. Drainage of the pelvis was obtained through a stab wound above the pubis, the general peritoneal cavity by cigarette tucks through the abdominal incision. The patient was returned to bed in fair condition. He did not do well after operation carrying a temperature varying between 98° and 103° and died April 14, 1921.

The autopsy revealed peritonitis as the cause of death.

Case 22. J. H., white; male; laborer; age 44; of Baltimore; was admitted to the University Hospital in a delirious condition with the history of a gunshot wound of the abdomen. Examination showed the patient to be in a markedly shocked condition. The radial pulse could not be obtained. The skin was cold and clammy and the patient was covered with a cold sweat. The hole of entrance was located on the right side just above the anterior, superior spine; that of exit just below the great trochanter of the left side. The man was infused before being taken to the operating room.

Operation, May 17, 1921, ether anæsthesia. iodine technique—resection of the ileum—died.

A right rectus incision permitted an inspection of the damage done. This revealed a laceration of the parietal peritoneum just above the right iliac vessels and of the parietal peritoneum on the left side immediately beneath the iliac vessels. The peritoneal cavity as suspected was full of blood, both free and clotted. The mesentery supplying the ileum was badly shattered and the ileum itself was torn so extensively as to make a resection imperative. Restoration of the continuity of the bowel was obtained by means of the Murphy button. Drainage was obtained by cigarette tucks and rubber tubes to the general and pelvic peritoneum. After the incision was closed, and before the patient was returned to his bed, a prophylactic injection of antitetanic serum was administered. The man never recovered from his collapse and died several hours after the completion of the operation. The autopsy revealed nothing of interest. Death was attributed to exhaustion from internal hæmorrhage following a gunshot wound of the abdomen.

Case 23. D. B., colored; male; schoolboy, age 6; of Baltimore; was admitted to the University Hospital, July 4, 1921, for a gunshot wound of the abdomen. He gave the history of having been shot with a stray bullet while walking in the street. On admission he had an anxious expression, but was apparently in no great pain. His pulse was 80, respiration 20, temperature 100°. The rectus muscles were rigid and the thighs were flexed on the abdomen. Examination showed a gunshot wound about 2 inches below the level of the umbilicus and about an inch external to and to the right of the mid-line, from which at least 6 inches of omentum was protruding. No wound of exit could be found. The voided specimen of urine was negative for blood.

Operation, July 4, 1921, ether anæsthesia, iodine technique—enterorrhaphy—died.

The abdomen was entered through a right rectus incision. The original wound and protruding omentum was not disturbed. The projecting omentum was cut off at its base and pulled through the bullet wound. The base was ligated and treated with alcohol and allowed to fall back into the peritoneal cavity. There was to be seen about 4 ounces of free blood in the peritoneal cavity. The gastro-intestinal tract was traced from the stomach to the rectum. A perforation was found in the ileum about 16 inches from the ileocæcal valve. This was closed with a pursestring suture of fine silk, and the line of suture reinforced with a continuous Lembert. There were two perforations in the cæcum, one in its anterior and one in its posterior wall. Both wounds were on the appendiceal side of the ileo-

cæcal valve. Both were closed by two rows of sutures. The bullet left the peritoneal cavity behind the cæcum and just external to the internal iliac vessels. As no other injury to the abdominal viscera could be found, appropriate drainage was instituted, the incision closed as far as possible, and the patient returned to the ward in fair condition.

The postoperative course of this patient was stormy and unfortunate. He first threw off a bronchopneumonia; then his wound broke down; and finally he developed a fæcal fistula, and died July 24, 1921, at 6:30 a.m., of inanition.

Case 24. N. T., colored; male; age 25; of Maryland; stabbed July 3, 1917, at 11:30 p.m., on the operating table at 12:45 a.m., returned to the ward at 1:45 a.m., and died at 4:45 p.m., July 4, 1917.

He was brought to the hospital in an ambulance with the history of having been stabbed in the abdomen 4 days previously. He had received first aid and at the time of his reception at the hospital had a dressing on the wound. He was suffering but little pain. His temperature was 99 3/5, pulse 104, respiration 32. His general condition was poor and little hope was held out for his recovery. After being placed in bed, examination revealed a somewhat painful and tender abdomen, rapid and shallow respirations, a quickened and small pulse, an anxious facies. Over the left lateral wall of the abdomen was a wound which admitted the tips of two fingers. It was discharging a very foul smelling, bloody serum. The abdominal walls were very tense thoughout. The patient was bathed in a cold clammy sweat.

Operation. July 4, 1917, 12:45 a.m., ether anæsthesia, iodine technique—enterorrhaphy, drainage—peritonitis, died.

The abdominal contents were reached through a left rectus incision. Upon opening the peritoneum, the intestines were seen to be covered with large flakes of fibrin, and they were intensely red and injected. The peritoneal cavity contained a large amount of a yellowish, foul-smelling material. A perforation, the size of a quarter of a dollar, was found in the descending colon, from which was escaping freely the intestinal contents. This was sutured and the peritoneal cavity flushed out with hot salt solution. Both the general and the pelvic peritoneum were drained with tube and gauze, and the wound closed down to the drains. The patient was returned to the ward in poor condition. He never reacted but gradually failed and died at 4:45 p.m., July 4, 1917. There was very little drainage from the tubes in the abdomen.

Case 25. M. B., colored; male; age 30; laborer; of Baltimore; was admitted to the University Hospital at 3:15 p.m., October 11, 1918, for a stab wound of the abdomen. Fifteen minutes previously, while in a drunken brawl, he was stabbed twice in the abdomen, once in the right epigastrium and once at a lower level and to the left of the mid-line. From the latter wound, a piece of omentum was protruding. Both wounds were about an inch in length. The one on the right side was situated immediately over the liver and just below the costal margin. The second wound was located slightly below the umbilicus and about an inch to the left of the median line.

Operation, October 11, 1918, ether anæsthesia, iodine technique—exploratory laparotomy, drainage—cured.

The abdomen was entered through a right rectus incision. After opening the peritoneal cavity the omentum was withdrawn, ligated, and excised. With the exception of an incised wound in the anterior surface of the liver, inspection of the abdominal viscera was without result. A quantity of blood had escaped from this wound and, as it was still oozing, the gap was closed with a mattress suture of silk. All three peritoneal cavities were drained, the pelvic through a stab wound above the pubes. The original incision was then closed as far as the drainage permitted, and the patient returned to bed in fair condition. This man's convalescence was without incident. He was discharged November 18, 1918, cured.

Case 26. G. U., white; male; tailor; age 41; of Baltimore; was admitted to the University Hospital, February 15, 1919, with the history of having assaulted his wife who in retaliation punctured his abdomen with a pair of scissors. The patient was a Lithuanian and could not speak English so no other history could be obtained.

Operation, February 15, 1919, ether anæsthesia, iodine technique—exploratory laparotomy, drainage—cured.

The wound was located in the right epigastrium a little to the right of the mid-line. As there was some doubt as to whether it had penetrated or not, the operative incision was made through the trauma. This revealed that the wound led into the peritoneal cavity. However, other than the cutting of a vessel in the omentum, which was still bleeding, no damage could be detected. The bleeding point in the omentum was tied. A hand in the pelvis detected a considerable collection of liquid blood. This was mopped out. Several drains were placed in the pelvic basin through a counter incision in the lower abdomen. Drainage of the upper abdomen was taken care of by appropriate measures, and the remainder of the abdominal incision closed. The man made an uneventful recovery. During his stay in the hospital he displayed an unbalanced mind, so he was transferred March 17, 1919, to an institution for the insane, but cured as far as the abdominal lesion was concerned.

Case 27. B. N., white; male; sailor; age 27; of Germany; entered the University Hospital, July 29, 1919, for a stab wound of the left side. The wound was about 1 inch long and was situated in the left side of the abdomen on a level with the umbilicus. It had been sutured on the outside by a physician. The man was in considerable pain. The abdominal walls were hard and boardlike and tender to the touch.

GUNSHOT WOUNDS OF THE ABDOMEN

No.	Died	Recovered	Race	Age	Sex	Occupation	Operation hours After Injury	Complications	Hollow Viscera Injured	Solid Viscera Injured	No Viscus Injured	Operation
1	Yes		C	30	F	Housewife	2	Pneumonia Toxæmia Exhaustion	Ileum, 12 holes	Mesentery, 8 holes		Enterorrhaphy Resection of intestine, Murphy button, anastomosis, drainage
2		Yes	C	33	F	Laundress	1	Abscess left buttock	Ileum, 2 holes Urinary bladder 1			Enterorrhaphy, drainage of bladder by rubber tubage, drainage
3		Yes	C	35	M	Laborer	4			Liver, kidney		Laparotomy, drainage
4	Yes		C	24	M	Stevedore	2	Hæmorrhage Exhaustion	Jejunum, 5 holes Colon, 2 holes	Mesentery, 1		Enterorrhaphy, drainage
5		Yes	W	8	F	Schoolgirl	3			Liver		Exploratory laparotomy, drainage
6	Yes		W	26	M	Clerk	2	Wound in chest Hæmorrhage; exhaustion		Liver Diaphragm		Exploratory laparotomy, drainage
7		Yes	W	19	M	None	2	Pleurisy		Liver		Exploratory laparotomy, drainage
8		Yes	C	17	M	Laborer	1	Pneumonia	Bruising of small intestine and colon			Laparotomy, suture of contused walls, drainage
9	Yes		W	16	M	Painter	3	Exhaustion, hæmorrhage	Colon, 3 holes	Liver		Enterorrhaphy, drainage
10		Yes	C	29	M	Chauffeur	3		Contusion of stomach	Liver		Exploratory laparotomy, no drainage
11	Yes		C	21	F	Housewife	3	Hæmorrhage; shock	Ileum, 10 holes	Mesentery		Enterorrhaphy, drainage
12		Yes	W	19	M	ex Marine	3	Pneumonia	Stomach, 2 holes	Liver, diaphragm		Gastrorrhaphy, suture of liver, drainage
13	Yes		W	71	M	Farmer	18	Peritonitis	Colon, 1 hole			Insertion of tube in colon, drainage
14	Yes		C	18	F	Housework	2	Collapse	Stomach, 2 holes	Liver		Gastrorrhaphy, drainage
15		Yes	C	32	M	Chauffeur	3		Stomach, 2 holes			Gastrorrhaphy, drainage
16		Yes	C	28	M	Laborer	1	Retention of drainage tube	Stomach, 2 holes			Gastrorrhaphy, drainage
17	Yes		C	31	M	Laborer	12	Hæmorrhage Peritonitis Gas infection	Small intestines, 5 holes, urinary bladder, 1 hole	Mesentery, 1 hole		Enterorrhaphy, suture of the urinary bladder, drainage
18		Yes	W	29	M	Mechanic	1	Wound in chest		Liver		Exploratory laparotomy, drainage
19	Yes		C	25	M	Laborer	1	Peritonitis Hole in duodenum overlooked	Stomach, 1 hole Duodenum, 1 hole	Liver		Gastrorrhaphy, suture of liver, drainage
20	Yes		W	28	F	Housewife	2½	Peritonitis Hole in sigmoid overlooked	Sigmoid, 1 hole	Liver, pancreas, Lesser omentum		Exploratory laparotomy, drainage
21	Yes		C	33	M	Laborer	3	Peritonitis	Ileum, 7 holes Colon, 1 hole			Enterorrhaphy, drainage
22	Yes		W	44	M	Laborer	4	Hæmorrhage Collapse	Ileum, large hole	Mesentery		Resection of ileum, anastomosis by Murphy button, drainage
23	Yes		C	6	M	Schoolboy	2	Pneumonia, fæcal fistula Exhaustion Secondary hæmorrhage	Ileum, 1 hole Cæcum, 2 holes			Enterorrhaphy, drainage

STAB WOUNDS OF THE ABDOMEN

No.	Died	Recovered	Race	Age	Sex	Occupation	Operation after Injury	Complication	Hollow Viscera Injured	Solid Viscera Injured	N. V. Injured	Operation
24	Yes		C	25	M		96 hrs.	Peritonitis	Colon			Enterorrhaphy, drainage
25		Yes	C	30	M	Laborer	1 hr.			Liver		Suture of liver, drainage
26		Yes	W	31	M	Tailor	Soon	Insanity		Omentum		Laparotomy, drainage
27		Yes	W	17	M	Sailor	Soon		Jejunum, 3 holes	Mesentery		Enterorrhaphy, wound closed
28		Yes	C	23	M	Laborer	1 hr.				Yes	Laparotomy, no drainage
29	Yes		W	6	M	Schoolboy	4 hrs.	Shock	Stomach	Spleen		Gastrorrhaphy, drainage
30		Yes	C	29	M	Laborer	1 hr.	Slight suppuration, abdominal wall			Yes	Laparotomy, drainage
31		Yes	C	18	M	Messenger	2 hrs.			Omentum		Laparotomy, drainage

Operation, July 29, 1919, ether anæsthesia, iodine technique—enterorrhaphy—cured.

The incision was made through the left linea semilunaris. The jejunum was found to be punctured three times and the mesentery once. There was as a result, a hæmatoma of considerable extent between the layers of the mesentery. The wounds in the gut were closed with fine silk. The only drainage was rubber tissue to the bottom of the stab wound thus permitting a tight closure of the operative wound. After an uneventful course, the man was discharged August 9, 1919.

Case 28. F. T., colored; male; laborer; age 23; of Baltimore; was admitted to the University Hospital, October 16, 1919, for a stab wound in the left, tenth costal interspace. It was about one-half inch long and deep. That it entered the peritoneal cavity was evidenced by the projecting of a piece of omentum through the wound. There were no signs of intestinal perforation or peritonitis. The man was in good condition, the pulse 110. The abdomen was not distended or dull. There were no signs of concealed hæmorrhage.

Operation, October 16, 1919, ether anæsthesia, iodine technique—exploratory laparotomy, no drainage—cured.

The wound was in the mid-axillary line and had been received early in the morning. He was on the operating table about an hour after the injury was incurred. The abdomen was entered by following the original wound. No visceral injury was found. The protruding omentum was cleansed and allowed to drop back into its natural habitat, and the wound was tightly closed. The postoperative course was smooth, by the 17th the patient's temperature was down to normal and he was suffering no pain or discomfort of any sort. He refused to remain in the hospital any longer, so was discharged October 20, 1919. At that time his general condition was very good.

Case 29. W. O., white; male; schoolboy; age 6; was brought to the University Hospital, June 26, 1920, in a very serious condition. About 6 o'clock that afternoon the patient fell from a load of hay, the prongs of a pitchfork entering the left side of his chest and abdomen. The boy's respirations were hurried and his pulse fast. The abdomen was quite rigid. The whole left side of the chest was emphysematous. The temperature was 103.8, pulse 138.

Operation, June 26, 1920, ether anæsthesia, iodine technique—gastrorrhaphy—died.

The abdomen was entered by the lowermost prong which penetrated the soft tissues from behind the posterior axillary line and just beneath the costal margin. The abdominal cavity was entered through a left rectus incision. Inspection of the upper abdominal viscera showed the prongs to have entirely penetrated the spleen and to have entered the posterior wall of the stomach. The latter wound was sutured and capped with a piece of omentum. The lesser peritoneal cavity and splenic shelf were drained with one rubber tube and three cigarette wicks. The boy did not rally after the operation and died at 4:10 p.m., June 27, 1920.

Case 30. F. D., colored; male; laborer; age 29, of Baltimore; was admitted to the University Hospital, at 1 a.m., August 29, 1920, suffering with a stab wound in the left side of the lower abdomen, incurred during an altercation with a colored woman 2 hours earlier. Although more than 10 feet of the small intestine were resting on the outside of the belly wall, the man was quiet and in no great pain. The gap in the abdominal wall was some 3 inches long and running along the outer border of the left rectus muscle, from without inward and slightly obliquely downward. The pulse was not greatly accelerated and the respiration was quiet. The man was in no shock and had apparently lost very little blood.

Operation, August 29, 1920, ether anæsthesia, iodine technique—exploratory laparotomy, drainage—cure.

While the skin was being cleansed the protruding intestines were protected with a sterile towel. Before inspecting them for possible perforation or other damage they were washed off with normal salt solution. The toilet having been completed the abdominal wound was enlarged at both its upper

and lower extremities and the intestine then inspected carefully for trauma. As none was found the gut was returned to the abdominal cavity. One rubber tube and two cigarette drains were placed in the pelvis, two cigarette drains in the flanks and one in the soft tissues. The wound was then closed down to the drains, all of which emerged at the lower angle. The man was returned to bed in fair condition. With the exception of a slight superficial suppuration, the patient made an uninterrupted recovery and was discharged from the hospital, September 25, 1920, with the wound entirely healed, save epithelization of the drainage site which was however closed in up to the skin. He gave a 100 per cent Wassermann.

Case 31. T. H., colored; male; delivery boy; age 18; of Baltimore; was admitted to the University Hospital August 14, 1921, for a stab wound through the lower part of the left rectus abdominis muscle. The wound was located 2 inches below the umbilicus and in the mid-axillary line. There was no doubt that it had penetrated, as witnessed by the protrusion of 2 inches of the omentum. The belly wall was very rigid, but the pulse was good. The wound was inflicted about 2 hours before admission.

Operation, August 14, 1921, ether anæsthesia, iodine technique—exploratory laparotomy, drainage —cured.

The abdominal contents were explored through a lower, left rectus incision. Investigation of the entire intestinal tract was without result. Several bleeding points in the omentum were ligated. The section of omentum exposed to contact with the wound was resected and withdrawn through the knife tract. The stump was washed off with alcohol and allowed to drop back into the peritoneal cavity. One cigarette tuck and one tube were placed in the pelvis and one cigarette wick to the left kidney shelf. The abdominal wall was closed with the exception of the point of emergence of the drains. The boy was returned to the ward in good condition. With the exception of a moderate rise in temperature and pulse rate the patient made an uneventful recovery and was discharged September 21, 1921, cured.

These cases, 31 in number, were observed during the period from January 1, 1917 to September 1, 1921. Sixteen recovered, 15 died; 25 were males, 6 females; 19 were colored, 12 white; 23 were gunshot wounds, 8 stab. Of the stab wounds, 2 died, 6 recovered; of the gunshot 13 died, 10 recovered. Of the gunshot wounds, the hollow viscera were perforated 16 times, with four recoveries, 3 of which were of the stomach. Of the perforations below the pylorus, 11 in number, but 1 recovered. Of the 10 cases of gunshot wounds that got well 2 involved the stomach, 1 the stomach and liver, 1 the jejunum and urinary bladder, 3 the liver, 1 the liver and kidney, 1 a bruise of the small intestine and colon and 1 a contusion of the stomach. There is a possibility that five of the last six would have recovered operation or no operation. Until some method is devised, however, whereby the damage done can be accurately ascertained, direct inspection of the abdominal organs offers the best hope of cure to these patients, as with the means at hand nobody can foretell before operation the lesion. In 2 instances perforations in the hollow viscera were overlooked and these patients promptly succumbed to peritonitis. This has been the invariable rule with this type of cases in our clinic. Never have I seen a case of overlooked perforating gunshot or stab wound of a hollow viscus recover; that such a fortunate outcome may occur I am not prepared to contradict, but it has not been my good fortune to witness such a happy turn of events. Twelve of the deaths in the gunshot series occurred in cases in which the hollow viscera were perforated. Only 1 of these occurred in 4 perforating wounds of the stomach, leaving 11 deaths assignable to perforations in the small or large intestine, a mortality of 91.66⅔ per cent. Though the series is small and the mortality high, this is no brief against operation, as a possible 8 and a fraction recoveries in every 100 cases is far better than 100 deaths. The stomach series is a little more cheering in as much as there is a percentage of 75 per cent cures.

All of the deaths except two from the oversight of holes in the gut, were due to unavoidable causes, for the most part collapse from internal hæmorrhage. One is forcibly struck by the number of these accidents complicated by lung affections. In 4 instances the injury was followed by pneumonia, in 1 by pleurisy. In 1 case the death was attributed to gas bacillus infection. One patient was received 96 hours after the accident, 1, 48 hours, 1, 12. All of them died. All the rest were admitted from ½ to 4 hours after the receipt of the trauma.

Of the stab wounds three perforated the hollow viscera. Only one recovered, 33⅓ per cent. Case 24 was without operative treatment for 96 hours and was in poor condition.

He was operated on only with the idea of giving him a chance for recovery. In Case 30 the patient came into the hospital supporting with his bare hands 10 feet or more of small intestine coiled up on the outside of his abdomen. Fortunately the bowel was not injured and the man eventually made a good recovery. Though the result in the above series is not overly gratifying, it is no brief against the use of exploratory laparotomy.

None of the cases died in which no damage or but little damage was detected and two did succumb in which a hole in the bowel was overlooked. Although Captain Basil Hughes, R.A.M.C.,[1] reports 16 soldiers with such injuries who were not operated upon with 11 sent to the base, 3 of whom developed fæcal fistula, and 5 of whom passed blood per rectum, civil practitioners are not yet prepared to adopt non-operative measures when these patients are received sufficiently early after the receipt of the injury, until a better method of handling these cases has been proposed, tried, and proven.

[1] Brit. J. Surg., 1916, iv, [illegible]

THE REMAINING BREAST AFTER RADICAL REMOVAL OF THE OPPOSITE SIDE FOR CARCINOMA[1]

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In a review of one hundred and seventy-three operations for carcinoma of the breast, necessarily many interesting and some instructive facts have been ascertained. One of the most useful results of such an analysis, I believe will usually be found to be the information so acquired, is so disappointing regarding his permanent cures, as to lessen the conceit of the average surgeon.

I will not present even a résumé of the results of our studies in this series further than to discuss briefly the future of the remaining breast, giving especially consideration to that rather small group of women coming within the childbearing period, and having cancer of the breast. It is more than likely such a consideration would not have occurred to us, had we not happened to have had visits from two such patients within a very short period of time. Both of these visits being so close together, and presenting such an unusual condition of affairs, naturally focused our attention on the necessity of reviewing all our cancer of the breast cases with the object of ascertaining what effect pregnancy had on the remaining breast after the patient had already exhibited, to say the least, a "tendency to cancer," by having been the host of such a disease on a previous occasion.

With such an object in view, we ascertained there were only thirty-one of these cases in our series under the age of 40 years. We were successful in obtaining information concerning twenty-nine of this thirty-one, and, of this number, only two had become pregnant, and, the most important point of this study, hinges on the fact of both of these cases having developed carcinoma in the remaining breast.

Very briefly the essential facts of these two cases are as follows:

Case 1, age 34, first admitted April 16, 1912, with carcinoma about 4 centimeters in diameter in upper outer quadrant of left breast. Known duration of tumor about 8 months. Mother of three children—12, 8 and 4 years. Nursed all children without trouble and with sufficient milk in both breasts. Tissue and glands removed from axilla and from under the falciform or triangular ligament did not show any signs of malignant invasion. No glands were palpated in supraclavicular region. Sections of tumor showed carcinoma. No pain and no signs of malignant involvement, or of mastitis in the opposite breast were present.

This patient remained free of all symptoms until about 1 month before her return to hospital on May 18, 1916, practically 4 years interval, at which time she noticed her right breast contained a tumor which could be easily palpated, and, this in spite of the breast being considerably larger than normal, due to the existence of a 7 months' pregnancy. During the month in which patient watched the growth of the tumor, it increased very rapidly, and, when examined, suggested a zone of inflammatory infiltration for several inches around the tumor. Another radical operation was done, revealing a carcinoma of the upper, outer quadrant without involvement of the glands of the axilla, and having no attachment to the chest wall.

Four days after operation, while we were debating what to do concerning the pregnancy, the patient kindly solved the situation for us by expelling a dead fœtus. This patient was examined in September, 1921, and is apparently well. She has had no further pregnancies, having been instructed to use all possible precautions to prevent them. Sections of this tumor were sent to Dr. W. H. Welsh, and Dr. J. C. Bloodgood, both of whom also gave the diagnosis of definite malignancy.

Case 2. Age 32, first admitted June 14, 1911, and differs only from Case 1 in the following respects: Mother of one child of 12 years. After an interval of about 6 years, patient returned on June, 6, 1917, being about 8 months pregnant, and with a history of having noticed a lump in the upper, outer quadrant of the right and remaining breast about the sixth month of her pregnancy. This growth must have increased very rapidly in size for, when she reported to us, not only was the breast involved, but the patient presented many signs and symptoms of a general carcinomatosis. The patient stated when she first noticed the growth that it was not larger than a "small marble," and, as far as could be ascertained from her history, she did not have any symptoms of chest or abdominal involvement until about 1 month before her return to the hospital. No operation was advised, but she died on June 18, 1916. The family refused to allow an autopsy,

[1] Read before the Southern Surgical Association, Pinehurst, December, 1921.

so all the information we could obtain was through an abdominal incision which the undertaker was persuaded was necessary to embalm the body properly. This showed a general involvement of the abdominal viscera, being most extensive in the liver. The fœtal heart sounds ceased 4 days before the mother's death. Apparently there was no involvement of the uterus. No tissue was obtained at the autopsy for microscopic sections. Due to the numerous classifications at present employed in different clinics we thought best simply to use the term carcinoma and not to attempt any differentiation of type.

A review of literature shows many authors expressing the belief that there is some association between mammary changes due to pregnancy and carcinoma of the breast. Such a hypothesis is most natural and, especially so, when one recalls the histological anatomy of the breast, with its numerous lobes, lobules, and large number of acini lined with epithelium, and richly supplied with capillaries. This complex picture is made even more confusing by the marked changes, especially in the epithelium, incident to the preparation for lactation. In a slight deviation from normal in such a complicated transformation, one can find ready application for any of the usually accepted theories concerning the etiology of carcinoma.

It is more than probable there are additional factors other than the normal changes in the breast incident to a pregnancy, existing, and of these factors none holds a higher place in the realm of present day theory than the rôle played by any chronic irritation. We all recall a few years ago Dr. Bloodgood sending to numerous pathologists slides of questionable diagnosis between chronic mastitis and malignancy. The microscopical diagnoses received after such an extensive study from so many different sources, varied so greatly as to convince many surgeons that there must be a close association between these two conditions.

In considering the causative factors of mastitis, certainly pregnancy ranks high. In a recent reply from Dr. Walter E. Sistrunk, of the Mayo Clinic, he states: "For sometime I have felt that when a patient has carcinoma in one breast, and a definite mastitis in the other, both breasts should be removed, on account of the fact that I have, on several occasions, seen a carcinoma later develop in the breast where the mastitis was present. This may be done at one operation, or as a second operation according to the difficulty of the first operation."

As a study of literature did not reveal a report of any effort having been made to determine the future of the remaining breast in the advent of a pregnancy in this class of case, we wrote to a number of our surgical friends and an analysis of 62 replies received showed very clearly no such postoperative "follow up" has been made. Forty-six out of this number volunteer the information of having noticed that pregnancy apparently stimulated cancer to develop more rapidly no matter where the growth might be located.

In this series of replies there were reported 17 cases of carcinoma of the breast associated with a pregnancy. All these cases were seen late in the disease and all went to a rapid and fatal termination. These cases had not been preceded by an operation and as this information was volunteered, there was probably numerous other cases not mentioned.

One very interesting and the most important point ascertained from these replies is found in the fact of there having been only 15 instances in which pregnancy is known to have occurred after removal of a breast for carcinoma. Of this number 13, practically 87 per cent, developed carcinoma in the remaining breast, 12 of whom died very promptly. The interval period between operations and recurrences associated with pregnancy varied from 2 to 10 years.

Dr. Irvin Abell states that he has had only one case to become pregnant "and she had an induced abortion at the end of the third month—this abortion was done in the fourth year following operation, now 2 years ago, and the patient remains well." This case was not listed because it is impossible to estimate what would have happened if the pregnancy had been allowed to continue. Certainly the abortion was induced because of fears of the damage resulting from continuation of the pregnancy.

We did not include in this estimate a case reported by R. L. Payne, of a woman

having had a radical breast amputation on the right side at the age of 41. "At the age of 45 her menstrual flow stopped suddenly," and she reported back to Dr. Payne with symptoms suggesting pregnancy and a definite lactation in the left and remaining breast. There was no pregnancy present, but Payne expressed the opinion that "the lactation had evidently been incited by the fear of pregnancy." Twelve months after lactation ceased Payne did a "radical amputation of the breast which showed in the laboratory infiltrating adenocarcinoma just below the nipple in the upper quadrant." This last operation was in 1910 and the patient is still living."

Due to the numerous classifications at present employed in different clinics, we thought best simply to use the term carcinoma and not attempt any differentiation in type.

Fred L. Hoffman, LL.D., etc. statistician, Prudential Insurance Company of America, was unable to give any data on the occurrence of cancer in the remaining breast either with or without the existence of pregnancy. No further information as regards such percentages can be obtained from literature or from replies received from these 62 surgeons, though, as we all surmise, recurrences are apparently more apt to occur in younger people than those of the sixth or seventh decade.

In our 27 cases under 40 years of age who did not become pregnant, there was not a case of recurrence of the cancer in the remaining breast; although the recurrences elsewhere in the body where much higher in this group than in the rest of the series, all of whom were over 40 years of age. Of this group over 40 years of age, we obtained definite information from 106—only 9 of whom, or less than 10 per cent, developed cancer in the remaining breast, and this in spite of the fact of our recurrences being as high as most of the recently published reports.

In the reply received from James F. Mitchell he reports a case having a 13-year interval, and then developing carcinoma in the other breast, but not associated with a pregnancy.

In a review of 218 cases of carcinoma of the breast from Rochester, Minnesota, 10 per cent more of those over 50 years were alive from 5 to 8 years after operation than of those under 50 years, suggesting there might be some ground for the rather prevalent opinion "the younger the patient the more active the malignancy."

If these observations and deductions are correct, we believe that surgeons should warn their patients, who are in the childbearing period and from whom a carcinoma of the breast has been removed, not to become pregnant for fear of serious trouble in the remaining breast.

NOTE.—Since writing the above article my attention has been called to a most interesting paper by Dr. Alson R. Kilgore, published in the *Journal of the American Medical Association*, August, 1921, "The Incidence of Cancer in the Second Breast." Dr. Kilgore does not analyze his cases in relation to subsequent pregnancies, but states that if the patient survives five years she is "from three to four times more likely to develop cancer in the second breast than a normal woman of the same age in either of her two breasts." To anyone interested in the subject of cancer of the breast, Dr. Kilgore's work will be of great interest.

HYPEREMESIS GRAVIDARUM[1]

BY CHARLES L. PADDOCK, M.D., F.A.C.S. (CHICAGO)

THE use of the duodenal tube for diagnostic purposes and treatment of gastroduodenal disorders is familiar to most of us, but, as far as I know, the use of the tube in the treatment of hyperemesis gravidarum, excessive vomiting of pregnancy, is not usual. I can find no report of cases of hyperemesis gravidarum having been so treated.

My attention was directed to its use in such cases by Dr. Milton Portis some two years ago, and it was used at that time with marked success as will be seen in Case 1. Since then I have had but three similar cases which could not be corrected by the usual treatment for excessive vomiting of pregnancy. Two of these I successfully treated by the use of the tube but the third patient refused to be so treated and continued to pull out the tube. Failing in her case the uterus was emptied.

It is not the intention of this paper to enter into the discussion of the etiology of hyperemesis gravidarum, numerous theories have been advanced to explain its cause and the medical literature is full of articles written upon this subject. Theories are not facts and this is evident when we read the numerous theories which are assigned for the cause of hyperemesis gravidarum. No sooner will one cause be given than it will be replaced with another. I doubt that we are any nearer a solution of the etiology of this distressing condition than we were 10 years ago. Suffice it to say we have in hyperemesis gravidarum a condition which at times baffles the most skilled clinician and occasionally leads to the death of the patient.

Hyperemesis gravidarum usually occurs early in pregnancy, after the seventh week, and while we often find it occurring in the latter weeks of pregnancy, it has occurred to me that it is not of a different etiological factor from that occurring later.

The late vomiting seems to belong to that class of toxæmias which are considered as pre-eclamptic; and as it is one of the multiple manifestations of the toxæmias, it not only calls for attention from the obstetrician but from the gynecologist, from the ophthalmologist, and from the internist. The physiochemist and the neurologist are often consulted. A recognition of this fact by any physician having a severe case of vomiting in his care may be of vital interest to his patient, as well as a great source of satisfaction to himself.

Nausea and vomiting in early pregnancy is frequent, statistics varying from 30 to 60 per cent, and the degree varies from a mild to a very severe form. There is no way to determine beforehand whether or not a patient will suffer from this distressed condition. The fact that she has been exempt from it in a previous pregnancy does not necessarily mean that she will be in a succeeding one. I have a patient at present who is in her third pregnancy and is suffering from very severe nausea and vomiting. Preceding pregnancies have been perfectly free from either, although there are no pathological lesions which can be found to cause it.

Vomiting of early pregnancy may be divided, for convenience, into three stages:

First, there is the disagreeable nausea with slight vomiting of mucus which comes on soon after the first missed menstrual period. The patient may crave food which usually is indigestible and unpalatable, rejecting other foods and able to keep down the former.

The second stage is ushered in with constant nausea, all food and liquids being rejected and soon the vomitus contains bile and blood. The urine becomes scanty and albumin and casts appear. The skin becomes dry and hot, although there is little if any rise of temperature. Diacetic acid and acetone are present. This condition goes on for a week to two weeks, the patient gradually becoming dehydrated, the symptoms increasingly severe.

The third stage is ushered in with marked acidosis, perhaps less vomiting and more or

[1] Read before the Chicago Gynecological Society, November 18, 1921. (For discussion, see p. 689.)

less delirium. Scanty urine with an increase of casts, blood, and albumin, a thready, weak pulse and a slight rise of temperature. Frequently at this time all vomiting ceases and the patient seems on a fair way to recovery, food is taken and apparently the organs are functioning normally, but the damage already done to the liver and kidneys is too great and the patient dies. The postmortem findings are usually those of acute yellow atrophy.

That we have no specific treatment for this excessive vomiting is evidenced by the multiplicity of drugs which have been, from time to time, held up to the profession as specific, only to be cast aside later as of very doubtful value. As specifics we have been given ingluvin, the blood of a puerperal woman, or a placental extract, thyroid extract, and corpus luteum; we have also been deluged with literature upon this subject, not only from proprietary drug houses but from men who stand high in our profession. Please do not misunderstand me; I do not wish to say all of these agents are not useful but that they are not specific I contend.

It is not so very long since we were advised to use extract of corpus luteum, by mouth, then to use it intramuscularly, and now it must be given intravenously, the latter said to be the only way to get results. But why such great claims only a short time ago when given by mouth? I am always very skeptical when shown statistics furnished because of the use of "specifics."

Hyperemesis gravidarum in early pregnancy is rare; vomiting in early pregnancy is not so rare, and one must learn to differentiate the two. This is why we have so many "specifics." The physic-element plays a very important part in the cure of vomiting of pregnancy. This fact, however, must not permit us to forget the possibility that a so-called physiological vomiting of pregnancy may not become, through neglect in treatment, a pathological one,—that is a hyperemesis. I do not like the term "physiological nausea and vomiting," and the sooner our textbooks omit that term the better.

Every case of nausea with vomiting in pregnancy should be considered as an abnormal condition demanding the attention of the physician. How often the patient is told that vomiting must be expected and that at a certain time in the pregnancy it will stop. It is just such advice as this that places the life of the woman in jeopardy. But recently I saw a case of vomiting carried to the limit, the attending physician claiming that he had never had a case that failed to recover. This one died.

To terminate the pregnancy is the last resort in the treatment of hyperemesis gravidarum, and unless the vomiting has been allowed to go too far beyond what we may call the danger line, the result of such treatment has been miraculous. From days and weeks of nausea and vomiting the patient's recovery is like magic. No sooner is the uterus emptied of the ovum than all nausea and vomiting cease. The product of conception, however, is sacrificed and it is because of this fact that I wish to report results by another treatment which will do away with the termination of the pregnancy in many cases.

Case 1. Mrs. W., age 30. Trained nurse before marriage. Small bones. Slight build; weight 95 pounds, when well. June 5, 1918, entered St. Luke's Hospital because of severe vomiting, about 3 months' pregnant. Was in very poor condition physically vomiting almost continuously; very little food or water for 2 weeks previous to entering hospital. Tissues dehydrated and symptoms of starvation. Usual remedies used with poor result. Urine scanty, marked acidosis, hyaline casts. The duodenal tube was passed, and after 6 hours was found to be in the duodenum. Sedatives and fluids, peptonized milk and cream were given in small quantities. Temperature and pulse remained normal. Nausea and distress continued. For some reason not explained in history sheet tube removed on the twenty-fourth and passed again on the thirty-first. After this the patient made a satisfactory recovery. Due to a justominor pelvis, a cæsarean operation was performed on December 20, 1918.

Case 2. Mrs. McKee, age 33, married 10 years. One child 7 years of age. Last menstruation about June 5. Menstrual history normal, 28 day type. Has "hay fever" every summer. Otherwise general health good. Saw her at home about August 1, was then about 3 months pregnant. Has been unable to keep liquids or food on stomach for 3 weeks. Patient very much depressed and had evidently lost much in weight. Her husband being a physician had used everything known in line of treatment. Rectal feeding, with all fluids restricted by mouth, had been tried with no success. Patient's skin dry

and tissues dehydrated. Patient removed to St. Luke's Hospital and on August 15 the Rehfus duodenal tube inserted. The daily report taken from the history sheet is as follows:

August 14, 1921. Duodenal tube passed. Feeding commenced. Tube in place in 6 hours. Depeptonized milk, water, total 24 hours, milk 83 ounces retained, no attempt at vomiting—slight nausea.

August 17, 1921. Patient doing well. No emesis, Fluids—corpus luteum intravenously.

August 19, 1921. Subjective symptoms much improved. Liquids—no emesis. No distress from tube.

August 20, 1921. An attack of hay fever lasting through the day (evidently an acute coryza).

August 21, 1921. Tube removed after 7 days, patient appearing like a different person.

August 23, 1921. Subjective symptoms very good; taking solid food.

August 25, 1921. Patient not so well. Complains of waves of nausea—emesis late in the day.

August 27, 1921. Emesis profuse. Restless. Rectal feeding. Very much depressed.

August 29, 1921. No improvement. Tube passed. Feeding commenced after six hours.

August 31, 1921. Subjective condition much improved. No distress from tube.

September 1, 1921. Complains of distress and some pain over whole abdomen. Milk of magnesia in small quantities, much relief. Bowels moving freely.

September 3, 1921. Patient removed to her home. An apparent gain in weight. Tube not removed. Feeding by tube continued for 1 week longer and tube removed.

Patient passed out of my hands but I understand made a fine recovery. I saw her 10 days after she left the hospital and then she was up and around. Had much improved in weight and general condition good.

Laboratory report. The blood chemistry examinations which were made two or three times by Dr. Williams gave us no information as to the severity of the case.

The urine always contained traces of albumin, high specific gravity, and hyaline and granular casts. There was no tenderness over the liver, but the patient gave the picture of one very sick.

This case was one upon which I would formerly not have hesitated to interrupt the pregnancy. In this case I did not at first have the co-operation of the patient, and I am sure the husband was impatient at my optimism for the success of the treatment. Much depends upon the hearty co-operation of the patient.

Recently I had a similar case but, if anything, much nearer the danger line. Starvation symptoms were much in evidence. The tube was passed but the patient would repeatedly remove it. I pleaded with her because of my fear that the case had progressed too far. It looked like a very poor risk for an abortion. She being a devout Roman Catholic gave me hope but I was compelled to empty the uterus. Like magic this patient recovered.

Case 2. Mrs. M., primipara, married 4 years. In consultation with Dr. A. W. Woods. Menstrual history normal—28 day type. General health good, always good. No extensive illness. No operations. Last menstruation March 1, 1921. I saw this patient in consultation with Dr. Woods June 1. She was pregnant about 3 months. Vomiting was severe. Patient very much emaciated. Marked acidosis; urine scanty. High specific gravity, with albumin and hyaline casts. Occasional blood in the vomitus. Patient appeared very sick. Skin dry. Pulse 100-110. Blood pressure, systolic 130, diastolic 90.

As Dr. Woods was to leave the city the next morning, he had decided to empty the uterus that day. At his request I took charge of the case. The tube was passed immediately. The tube entered the duodenum in 4 hours and feeding commenced. The success in this case was remarkable. In one week the tube was removed and the next day she was taken home. No study of the chemistry of the blood had been made in this case, nor of the nitrogen partition of the urine.

Here then are three cases which ordinarily would have been terminated by abortion. They were all sick. The bedside picture showed them to be desperately so, emaciated, listless, begging to be relieved of their distress, and the clinical findings showed beginning destructive organic changes. These patients are alive, two of them have had their babies, and the other one is about at term.

As far as I know this is the first report of a case of hyperemesis gravidarum, or excessive vomiting of pregnancy, which has been treated by duodenal feeding, and while three cases are not enough to prove that all cases of hyperemesis gravidarum may result as successfully I am satisfied that the tube has its place in the treatment.

CHILDBIRTH

Primitive versus Modern[1]

By C. H. Davis, M.D., F.A.C.S., Milwaukee, Wisconsin

THE geological records of prehistoric man give some idea as to how he lived. We know that the sex instinct must have played an important part in his struggle for existence. To what extent the early woman of our race was treated differently from the female of the higher mammals, we can only guess. Probably childbirth for her was not dissimilar to that of the higher apes of today. But with no written word from neolithic man, we must turn to the primitive peoples of our own age for study of labor among primitive races.

America, with its Indians, negroes, frontier and growing cities with emigrants from all countries, gave obstetricians of the past century the unusual opportunity of being able to study the primitive in obstetric art as well as the most modern. Therefore, it is only natural that a St. Louis obstetrician, George J. Englemann, should have written his very interesting and instructive book on *Labor Among Primitive Peoples*. To Dr. Englemann's book we are indebted for descriptive drawings and much of our information regarding primitive childbirth.

Empirical obstetrics dates from the early centuries of man's existence, and is the practice of all primitive peoples in all ages. During the early centuries before races intermarried, pregnancy and childbirth was a more purely physiological process than it is today, and doubtless it caused woman very little discomfort. Woman probably gave birth unaided and there was little regard for either fœtal or maternal life in event of complications. Natural law prevailed and, therefore, only the fittest of each generation could long survive. Large families were an economic asset and early man valued his wives, partially at least, according to their fertility. This was true in early Biblical times.

At the dawn of history intuitive obstetrical practices were probably as well developed as was possible with the complete ignorance of anatomy and physiology. Sometime in the past ages the older women who had borne children began to assist the younger during the ordeal of childbirth. Some of these must have possessed superior skill and they in turn instructed others in the use of varying postures, massage, and nauseating drinks. Midwives, empirically educated, were found in all of the old civilizations and semi-civilizations.

Judging from the earliest written records, maternity has appealed to the sympathies as well as the most sacred instincts of all peoples. It is undoubtedly true, as Englemann suggests, that the obstetric practice of a tribe or nation is indicative of its civilization, culture, and morals. With the development of his intelligence, man developed a religious instinct, and this in turn created a new attitude toward the relation of man and woman. For in *Genesis*, 2:24, we read: "Therefore shall a man leave his father and his mother, and shall cleave unto his wife and they shall be one flesh."

Empirically trained midwives had a well-recognized position among the Israelites at the time of the exile into Egypt; for in *Exodus*, chapter 1, verses 15 and 16, we read: "And the King of Egypt spake to the Hebrew midwives, of which the name of one was Shiprath, and the other was Puah: And he said, 'when ye do the office of a midwife to the Hebrew women, and see them upon the stools; if it be a son, then ye shall kill him: but if it be a daughter then she shall live.'" This also indicates an early use of the obstetrical stool or chair which was an outgrowth of sitting on another person's lap during childbirth, referred to in *Genesis*, chapter 30, verse 3, where Rachel says: "and she shall bear upon my knees."

Among semi-civilized peoples the priests were presumed to be the most intelligent of all men. It is, therefore, natural that when her empirical methods failed, the midwife

[1] Read before the Chicago Gynecological Society, November 18, 1921. (For discussion, see p. 686.)

should turn to them for assistance. At first it is probable that the priesthood gave only spiritual aid in the hope of driving out the evil spirits which interfered with the escape of a child from its mother's womb. However, we know that in Egypt and Greece they gave mechanical aid. At a very early date cæsarean section is believed to have been performed by priests. The first crude instruments for the mechanical removal of a dead fœtus were probably designed and used by them.

Hippocrates (400 B.C.), the father of western medicine, gathered and to large degree disseminated the obstetrical knowledge of his time. He established medicine as apart from religion, and the physican became the one skilled in operations to remove the fœtus which could not be born. During the preanatomic epoch which followed Hippocrates, obstetric practice remained in the hands of empirically trained midwives. Cephalic presentations alone were hopeful. The obstetric chair was in common use and carried by the midwife from house to house. Destructive obstetrical operations were taught as a branch of surgery, but the physician was never called until after the death of the child.

We are told that the obstetrical teachings of Hippocrates became known to the Arabs and were carried by them to the East and West. His teachings penetrated to Rome shortly before the Christian era. Celsus (30 B.C. to 14 A.D.) and Soranus (under Trojan, 98 to 112 A.D.) made real contributions to obstetrics. Hippocrates' teachings may have reached India and the Orient, but it is equally probable that they developed similar ideas more or less independently. The medical men in all countries probably started with the religious laws and obstetric precepts of the priesthood, and century by century as they gained some knowledge of the gross palpable anatomy of the woman, tried to improve the operative measures. Soranus was the first, so far as we know, to teach podalic version before the death of the child; but when this was impossible, he, like the others, resorted to embryotomy. "The teachings of Soranus mark the highest development of the obstetric art in the ancient civilization of the west; fathered by Hippocrates, fostered by Celsus, it was perfected by Soranus, with whom independent original work and progress cease for fifteen centuries." (Englemann.)

There has been more progress in obstetrical development during the past century than during the many thousands of years since the first of the paleolithic men roamed the European and Asiatic wilds. That knowledge of this important function of woman should have developed so slowly seems strange until we recall that: "It was woman who gave aid to her sister in childbirth; the obstetric art was in the hands of women—women of low caste; it was looked upon as woman's work, and progress was thus impeded, if not impossible. While the aid of priests, or men possessed of mystic powers, was sought for in difficult cases, they were at other times carefully excluded from the lying-in room, and thus prevented from gathering the experience necessary for progressive innovation. It was eminently the sphere of women, and so considered until the era of modern scientific medicine. We need but recall the fate of Dr. Wertt, of Hamburg, who in 1522 put on the dress of a woman to attend and study a case of labor, and was burned alive for his pains; or that of Dr. Willughby, one hundred years later, who assisted his daughter, a midwife, in a difficult labor, and was obliged to crawl into the darkened room on hands and knees. The title of *meauti*—man-grandmother—was given by the Greeks in the time of Hippocrates (400 B.C.) to men called in difficult cases; this spirit pervaded up to the scientific period, as indicated by the appellation of 'man-midwife' given to Chamberlain, the inventor of the forceps, in the middle of the seventeenth century; and the adherence, even now, of the mass of the people to the midwife of the older countries, show how deep seated this feeling is. During that entire era of empiricism, progress was possible only as far as the eye could reach; the important parts were concealed, the mechanism only to a slight degree exposed. Without means of penetrating or bringing to view the mystic process, actual progress was out of the question, and did not take place until the scalpel

opened the way and medical men entered upon the art in the middle of the sixteenth century." (Englemann, *History of Obstetrics.*)

MODERN

The rediscovery of internal podalic version by Paré in 1550 was the first of the great steps in the development of scientific procedures in obstetrical practice. Or should we say the application of scientific principles to the art of obstetrics? The development of the obstetrical forceps beginning with Chamberlain's secret use in 1647; the detailed study of normal and abnormal labor; the limitation of craniotomy due to the perfection of delivery by version and forceps, and the reappearance of the induction of premature labor; the discovery of the cause and nature of childbed fever by Oliver Wendell Holmes (1843) and Semmelweiss (1847); the introduction of anæsthesia by Simpson in 1847; the description of combined version by Wright, of Cincinnati, and a little later by Braxton Hicks, of London, in 1854; the application of antiseptic methods to delivery-room technique in 1870 by Stadfeldt, of Copenhagen; and the performance of conservative cæsarean section by Sanger in 1884 are the great landmarks in the growth of present obstetrical methods.

Mauriceau, who lived in Paris at the end of the seventeenth century is said to be the first physician who devoted himself exclusively to the study and practice of obstetrics. Ambroise Paré, a century earlier, had been noted as a surgeon as well as an accoucheur. "It was not, however, until the middle of the eighteenth century that obstetrics was divorced from its intimate connection with surgery, and also disencumbered from the trammels of ignorance, superstition, and empiricism, which had so greatly retarded its progress." (Hodge.) Smellie in England and M. Levret in France greatly improved the obstetric forceps and their teachings lead to a rapid increase in the number of practitioners of this branch of medicine in their respective countries.

DEVELOPMENT IN AMERICA

Among the early American obstetricians was James Lloyd a graduate of Harvard University and a student of Smellie's, who began practice in Boston in 1752. Thomas Bond and his brother Phineas Bond were early obstetricians of Philadelphia. William Shippen, Jr., returned to Philadelphia in the spring of 1762, after studying with William Hunter and McKinzie in London, and in the fall of the same year began a course of lectures upon anatomy, surgery, and midwifery, thus laying the foundation for the first regular course of medical instruction in the United States. He and John Morgan founded the Medical College of Philadelphia, now the University of Pennsylvania. John V. B. Tennant was the first professor of obstetrics in Kings College (now Columbia), the medical department of which was started in 1767. Harvard University appears not to have had a department of obstetrics until 1815 when Walter Channing was appointed lecturer upon obstetrics and medical jurisprudence. He was instrumental in America for the early popularization of anæsthesia during labor, and in 1848 wrote a monograph on this subject.

During the nineteenth century medical schools multiplied in every part of the United States. In all of them some obstetrics was taught. To William P. Dewees is given the credit of first attempting a broader course of training in obstetrics, when in 1797 he gave private lectures in Philadelphia. In 1808, Wistar was appointed professor of anatomy and midwifery in the University of Pennsylvania. It was due to his suggestion that in 1810 Thomas C. James was appointed professor of obstetrics and the diseases of women and children, but the course was not required for graduation until 1813 when the board of trustees passed the following resolution: "Resolved, That hereafter the professor of midwifery shall be a member of the medical faculty, and shall have all the powers, authority, privileges belonging to a professorship in said faculty; and that no person shall be admitted hereafter as a candidate for the degree of doctor of medicine in this university, unless he shall have regularly attended the lectures of the said professor for two years; provided, etc." To Dr. James, therefore, goes the honor of giving the first regularly recognized course of obstetrics in the United States.

Samuel Bard, of New York, published the first American work on midwifery in 1808. The previous year Dewees had secured the republication in the United States of Heath's translation of Baudelocque. Following this, various of the European works had American editions. Bard's fourth edition was enlarged for the use of medical students in 1817; and Dewees published his splendid system of midwifery in 1825. The next American text book was *The Philadelphia Practice of Midwifery* by Charles D. Meigs, published in 1838. Three years later he became professor of obstetrics in Jefferson Medical College. Henry Miller, professor of obstetrics in the University of Louisville in 1858, published the first work on midwifery issued from the middle west. This was followed by Gunning S. Bedford's *System of Obstetrics*. He was then professor of midwifery in the University of New York. But to Hugh L. Hodge in 1866 goes the honor of producing the first well illustrated obstetrics with one hundred and ten wood cuts. This work appeared at the end of his teaching career and after he had become emeritus professor of obstetrics and the diseases of women and children at the University of Pennsylvania. Dewees' second edition has only eighteen cuts at the end of the text. William T. Lusks' *Midwifery* published in 1881 and Barton Cooke Hirst's *American System of Obstetrics* published in 1888, are among the best known of the early works of the passing generation of obstetricians. The later works of Hirst, Webster, Cragin, Edgar, Williams, DeLee, and others are all well known to the more recent students. The famous obstetricians already mentioned and their co-workers developed the specialty of obstetrics to a height in this country which is not surpassed elsewhere. Our medical publications of the past century are rich in their contributions, but today, paradoxical as it may seem, the United States, of the more civilized countries, has the worst as well as the best in obstetrical practice. At least the investigation of Dr. Meigs of the Children's Bureau indicates that of sixteen civilized countries the statistics of which have been studied we stand fourteenth in deaths from childbirth.

Fig. 1. Patient draped for delivery with abdominal sheet tucked under back to show hip rest which is used to elevate hips during delivery of child. Pain is relieved with intermittent nitrous oxide-oxygen analgesia and the patient pulls on the straps as directed. Ether is added if needed during the last few "pains" and is usually administered for the repair of the episiotomy. With this hip elevation and technique it is not necessary to shift patient for mid or low forceps and there is no difficulty in delivery of aftercoming head in breech cases.

In a brief paper, it is obviously impossible to state even in outline all that has been done to make childbearing safer. Nor can credit be given to all who have helped develop the scientific procedures now in use.

Perhaps the greatest problem which confronted the early obstetricians was puerperal sepsis. Prior to the observations of Holmes and Semmelweiss the history of hospital maternities is to a great extent one of childbed fever. Nor were the epidemics confined to the hospital for in 1786 there was an outbreak in the plains of Lombardy from which not a single puerpera recovered. Today we have ample proof from the records of many maternities that puerperal sepsis is a preventable complication. The continued large number of deaths from it is certainly a strong indictment of general medical conditions. This is due in part to inadequate training of medical students, but still more to the subsequent difficulties of maintaining technique when the physician tries to do obstetrics in competition with the local midwife, working under similar conditions without means of maintaining asepsis or properly handling complications. Hospitalization is the only solution.

Craniotomy, the most repulsive of surgical procedures, while perhaps the oldest of obstetrical operations, is today rarely performed.

Except for the draining of fluid from a hydrocephalic monster it is not performed on a live child. The induction of premature labor, podalic version and axis-traction forceps led to a gradual reduction of the number of craniotomies performed during the past few centuries. Early recognition of actual disproportion and cæsarean section performed according to present surgical standards has led to a practical elimination of the operation. The Porro cæsarean and the more recent low cervical incision make it possible at times to do an abdominal delivery even when the previous handling of the labor is not above reproach.

After craniotomy, abdominal hysterotomy, long known as cæsarean section is the oldest obstetrical operation. It may even antedate craniotomy as it is known to have been performed by primitive peoples in Africa, and doubtless was at times resorted to by primitive peoples of the remote past. Long ago it was performed by Priests after the death of the mother.

Before the antiseptic and aseptic periods of surgery, however, cæsarean section was fatal in such a high percentage of cases, that it was rarely attempted. In the early antiseptic period 150 Porro operations showed a mortality of 54 per cent. While a little later when Saenger returned to the conservative operation there was a maternal mortality of 40 per cent in 40 operations (Englemann). Today the maternal mortality from cæsarean section is between 5 and 10 per cent, but in elective operations it should not exceed 1 per cent.

Cæsarean section is such an easy method of delivery and such a time-saving procedure, that since it is now relatively safe for the mother and practically insures a live baby, there is a growing tendency to resort to it at once when the labor promises to be difficult or tedious. While at the time the results may be very gratifying, yet it must be remembered that of every 100 women who have subsequent pregnancies, four or five may be expected to have a rupture of the uterus. While in the future there will be even more cæsarean sections performed than today, it is hoped this will result from a more careful selection of cases rather than due to a continued broadening of indications.

Prenatal care, securing as it does an early exmination of the prospective mother, and a continued careful observation during the course of pregnancy, has demonstrated that the severe toxæmias are for the most part preventable. While it has not been possible to eliminate the early nausea and vomiting, we are now able to relieve the patient, and today it is very rarely necessary to terminate the pregnancy because of vomiting. Early removal of all foci of infection with careful regulation of diet and limitation in the increase of weight will to a great extent prevent the late toxæmias. Prompt eliminative treatment, and when this fails, premature induction of labor has largely removed the danger of eclampsia. With evidence of kidney suppression and an impending eclampsia, the slow intravenous administration of 18 to 20 per cent glucose solution will usually improve kidney function. The substitution of morphine for chloroform when convulsions do occur means a saving of lives. Threatened eclampsia is not, *per se*, a proper indication for cæsarean section.

Ideal handling of an obstetrical case entails caring for a woman during pregnancy, labor, and the puerperium in such a way that she will come through with a healthy baby and without impairment of her own health. However, the average woman thinks little of the possible dangers, accepting them as the sacrifice which she must make. The pain of labor, temporary and intermittent though it is, causes her more worry than any of the possible complications. Gradually, since the day of Simpson, methods have been devised to control this pain, until today the woman may be carried through labor with comparative comfort. The day has passed when a woman in labor should be permitted to suffer to such a degree that the entire hospital is disturbed by her cries. Judicious use of hypodermic medication during the first stage and nitrous oxide-oxygen or well-vaporized ether during the second stage makes labor more bearable, and today obstetrical patients should be as quiet as surgical. That this sort of care requires more careful watching dur-

ing labor is perfectly true—however, obstetricians who deliver women with the minimum of pain would forsake obstetrics before returning to the old method with its contusion and unbearable shrieks. Relief of pain during labor conserves the woman's strength, lessens the dangers of complications during the puerperium, and favors an early recovery. Primitive women may have had an easy labor and little discomfort, but civilized woman has a highly sensitive nervous system and her pain is real. More than 30 years ago Lusk warned us that: "As the nervous organization loses in the power of resistance as the result of higher civilization and artificial refinement, it becomes imperatively necessary for the physician to guard her from the dangers of excessive and too prolonged suffering."

During the past few centuries the care of women in childbed has been gradually transferred from the practical midwife of the community to the family physician. The early benefits of this transfer is apparent from the lower mortality shown in the following table.

AVERAGE NUMBER OF MOTHERS DYING IN CHILDBED IN LONDON

For 20 years ending in 1680,	one in every	44 delivered
For 20 years ending in 1700,	one in every	56 delivered
For 20 years ending in 1720,	one in every	69 delivered
For 20 years ending in 1740	one in every	71 delivered
For 20 years ending in 1760,	one in every	77 delivered
For 20 years ending in 1780,	one in every	82 delivered
For 20 years ending in 1800,	one in every	110 delivered
For 20 years ending in 1820,	one in every	107 delivered

In 1840 one woman died in childbed for every 168 women delivered in England and Wales. But in the birth registration area of the United States, one woman died, in 1915, for every 164 live births.

The practical midwife is rapidly being eliminated. During the past 10 years, the number of midwife deliveries in Milwaukee has dropped from 4,198 in 1911, to 1,988 in 1920. The number of confinements conducted by physicians has for the same period increased from 6,689 to 9,088. If in the future there is not a further lowering of the mortality and morbidity from childbirth, physicians must take the blame. For all women of childbearing age (15 to 45) childbirth is the second greatest cause of death. The records of life insurance companies show that for all women insured before the age of 45, the diseases of pregnancy and the puerperal state are the second greatest cause of death. All women are exposed to tuberculosis or it could not hold its lead over childbirth as a source of danger to the younger women.

The greatest obstetrical need of today is not more knowledge regarding its complications, but rather, to use a commercial term, better distribution. A delivery is an operation. It is just as safe to put a finger into the peritoneal cavity as into the vagina during labor, and the technique for one should be as rigid as for the other. Emergency operations are still performed in a house when necessary but not from choice. Surgeons require their patients to go to hospitals. Many hospital beds are now used for medical cases. People are educated to the great advantage of going to a hospital for a diagnosis or an operation. A few obstetricians, require their patients to go to the hospital. Safe care in the home is possible, but this means turning it into a hospital for the time and for the average family the cost is prohibitive. The family physician is asked to deliver his patients in a bedroom or kitchen, without the facilities or assistance to meet possible complications. A careful technique is almost impossible. And yet we wonder why childbirth remains so dangerous in an age when surgery is relatively so safe?

DEPARTMENT OF TECHNIQUE

THE "BIPP" METHOD OF TREATMENT

Bone Cavities and Bone Grafts

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IN several addresses and papers I have drawn attention to the "bipp" method of treatment of war wounds, and early in 1918 I summarized all of my information in a small book entitled *Bipp Treatment of War Wounds* and published by the Oxford Press.

In all of my publications I have claimed that by this method, properly applied, it is possible to close infected wounds without drainage, always with impunity and frequently with the result that "healing by first intention" follows.

This is a big claim for it means that a new surgical principle has been established, viz., that if an infected wound be treated by (1) thorough operative measures and (2) suitable antiseptic methods it often need cause little more trouble than a clean one does. I do not claim that the last word has been said yet, but it is possible at the present time to get results which are startling to those who have not carried out this treatment according to the ritual I have described. That it may be more difficult than I have appreciated is suggested by my experience with junior colleagues at the War Pensions Hospital, all good and enthusiastic surgeons (Mr. Cuff, Mr. Russell, and Mr. Irwin). They had tried the "bipp" method in many cases, sometimes with excellent results but also with not infrequent failures, before I joined them. After participation in my work, they obtained as good results as my own, and did not hesitate to acknowledge that the change in their methods had brought about a remarkable improvement in their cases.

It is so difficult to convince the majority of surgeons that their outlook may be wrong that the strongest possible evidence to this effect is necessary, and it has to be offered over and over again before it has any chance of gaining acceptance. Bacteriology has done so much for surgery that surgeons are for the present obsessed by it, and most of them will listen to nothing except it be fully supported by bacteriologists of repute. It will be many years yet before infected wounds are sufficiently understood to be satisfactorily treated on strictly scientific lines, and though that ought to be the ideal of every surgeon, he should not shut his eyes to the fact that it is so far an unattainable one, and, by refusing to accept proofs that some surgical progress may still be made by clinical experiments, retard surgical advance. Patients occasionally consult me "because they have heard that I have found a salve which heals wounds very quickly," and even doctors sometimes appear to think in a similar way. Nothing could be further from the truth. The whole method demands attention to the principle and every detail of it. The "salve" *may* be the least important portion, though for the present I do not think so, having found nothing equally efficient.

When I recall the condition of my wards at the Northumberland War Hospital, with 80 beds under the care of a house surgeon and myself, I am still overwhelmed when I remember the wave of enthusiasm I felt when the dreadful conditions existing then could be said to have been brought to a conclusion. We soon found in our first year that any interference with these painful infected wounds, except to keep them as clean as possible, did more harm than good, and surgery eventually had to be limited to drainage and frequent painful dressings. All the nurses and orderlies were overworked, and the dressings required so much of their time and attention that there was little chance of their being able to do much for the patients outside of these performances. My own feeling then was one of desperation, because so little could be done.

As a contrast to this I will mention our experience during the last year, when Dr. Pirrie

[1] An address given to the Northern Division of War Pensions Surgeons on April 28, 1921, and a demonstration at the meeting of the British Medical Association, on July 20, 1921. Published by leave of Colonel Greig, War Pensions Hospital, Newcastle-upon-Tyne.

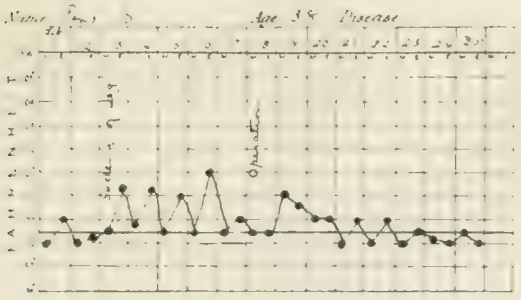

Chart 1. Case 1, showing temperature curve.

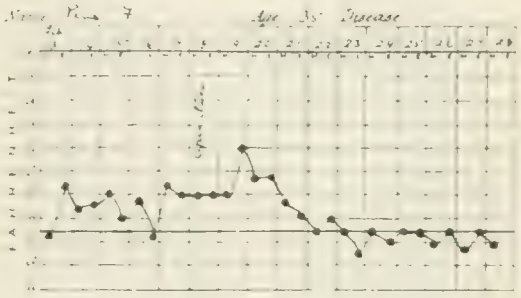

Chart 2. Case 2, showing temperature curve.

and I had almost three times the number of beds (200) under our charge. Every serious wound was treated by operation and the "bipp" method, and the consequence was that all dressings, except the minor ones, were done in the operating theater by Dr. Pirrie and myself on one or two mornings of the week, nurses and orderlies were freed from this work to attend to the wants of the patients, and no member of the staff was overworked. The change in the whole aspect of the wards was more remarkable still. Instead of being filled with an ill, complaining crowd of patients they were full of cheerful men, whose chief anxiety seemed to be to know when they could get up.

Though the "bipp" method has not so many opportunities of proving its value now, it has still many uses both in civilian and military service.

During the last years of the War, Mr. Richardson tested it in the Royal Victoria Infirmary by treating a series of compound fractures by "bipp," then fixing them with Lane's plates, with extraordinarily good results which I hope may be published.

My own War Hospital results with fractures without plates were also surprisingly good, for the majority, after we had learned how to treat them, were no more trouble after operation than simple fractures are.

The advantages of the "bipp" method of treatment were also emphasized by our results in cases of bone necrosis following gunshot wounds. Before adopting this method, wounds, following necrosis operations, were left widely open for drainage, but in spite of taking all the precautions known to us, septic "flares up" and more necrosis frequently followed our operations. I recall especially the case of a young soldier with necrosis of his femur following a gunshot fracture, on whom I operated four times for the removal of sequestra. Each of the first three operations was followed by an acute flare up and further necrosis of the bone exposed and damaged by the operation. On the fourth occasion the "bipp" method was adopted, and the wound, closed by sutures, promptly healed without trouble.

The first cases I have to show you are men who had large acute abscesses opened, "bipped," and closed by sutures.

Case 1. Pens. B., age 38. In the end of November, 1920, patient noticed a carbuncle on the back of his neck. This became irritated, because the top rubbed off when he was working in the mine. Since then he has had abscesses (1) end of December, in his right hip; (2) end of January, in his left leg below the knee; (3) about the beginning of February, in his side. All the abscesses were opened.

On admission January 12, 1921, he was very ill with bronchitis. He had a bedsore on his back, a carbuncle over his scapula, and another over his hip bone.

February 13, 1921. Large swelling on right leg, outer side, just below knee. Some œdema and redness of skin covering abscess. Deep fluctuation over area 4 inches by 3 inches.

February 18, 1921. Operation. Five-inch incision between tibialis anticus and extensor communis digitorum. Abscess found extending down to interosseous membrane. It was lined by a thick pyogenic membrane. About 1 ounce of pus was evacuated. Abscess cavity treated with "bipp" technique. Skin sutured with interrupted sutures of silkworm gut. Dry dressing. Boric powder on skin. No splints.

Bacteriological report on pus from abscess. Staphylococcus aureus present.

February 27, 1921. Dressed first time (9 days later). Pus was escaping between sutures, but no sign of inflammation and no tenderness were present. Sutures were still in position. To be dressed daily with spirit. Sutures left in.

March 8, 1921. Temperature 101°. Patient complained of pain "like rheumatism" all over his body. No discharge on dressing. No pus could be squeezed out of wound.

March 14, 1921. Right leg healed. Patient has had a slight, tender swelling in right flank resembling a threatened perinephric abscess.

Summary. Acute abscess holding 1 ounce of pus opened, "bipped," and closed by sutures. Healed in 15 days.

Though this abscess did not heal by first intention, all the symptoms, including the rise in temperature, disappeared immediately after

Fig. 1.

Fig. 2.

Fig. 3.

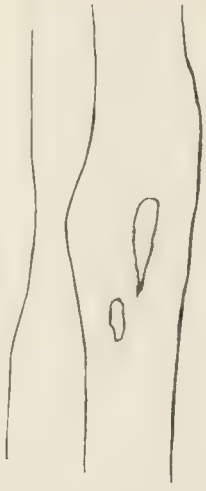

Fig. 4.

Fig. 5.

Fig. 1. Drawing showing condition in Case 5 before operation.

Fig. 2. Drawing showing condition in Case 5, 6 months after operation.

Fig. 3. Condition in Case 6, 131 days after operation.

Fig. 4. Condition in Case 6, 222 days after operation.

Fig. 5. Drawing showing condition in Case 7, 126 days after operation.

it was opened and no extension of it followed closure of the incision by sutures.

The patient's resistance was much diminished by general weakness, prolonged sepsis, and the formation of many metastatic abscesses.

Case 2. Pens. F., age 35. Gunshot wound left arm (fracture). Left thigh. Wounded October 16, 1917, France, by shrapnel. He was wounded all down his left side—face, arm, chest, and thigh. The thigh wound healed in January, 1918—no operations. His left arm was bone grafted for ununited fracture of radius in March, 1920.

February 2, 1921. Patient was admitted to the War Pensions Hospital for further treatment of his left arm. On February 7 he had pain in his wounded left thigh, which had been healed since 1918—no shiver. On February 13 his temperature was 100.4° and there was a large swelling in his left thigh. The skin over the abscess was red and œdematous.

February 18, 1921. Operation. Four inch incision. An abcess containing 1.5 ounces of pus underneath the tensor fascia femoris was opened. Cavity treated with "bipp" technique. Skin sutured with interrupted silkworm-gut sutures.

Bacteriological report on pus from abscess. Pure culture. Streptococcus. Hæmolytic.

February 21, 1921. Patient running temperature—dressed. Some bloody discharge could be squeezed from wound between sutures. Specimen was sent for bacteriological report. Wound was not tender at all. Redness and swelling gone. Bacteriological examination showed no growth.

February 27, 1921. Healed apparently by first intention. No further trouble.

Summary. Acute streptococcic abscess opened, "bipped," closed. Healed by "first intention."

In this patient a more virulent organism than in the first case shown was the cause of the abscess. His temperature consequently did not drop at once after the abscess was opened.

In spite of the organism and the acute inflammation, the wound healed right away.

Case 3. Pens. M., age 24. Gunshot wound left hand. Wounded in left wrist October 26, 1917, at Ypres. The wounds healed but kept breaking down. Several operations were performed. The thumb did not give trouble until February, 1920.

On admission February 23, 1920, there was found a sinus in palm over third metacarpal bone; two sinuses on wrist, one over flexor carpi radialis 2 inches above insertion, the other on medial surface of lower third of left forearm. Profuse discharge.

Lysol baths were given left hand, fomentations every 3 hours.

March 6, 1920. The hand was incised. Extensive necrosis was found. The flexor carpi radialis tendon was exposed and found separated from the adjacent tissue. Sinuses were incised and enlarged.

June 1, 1920. Sinuses in hand and forearm were still discharging freely.

August 4, 1920. There are two sinuses of tuberculous appearance and the size of a sixpence over flexor aspect of thumb (left); sinus in middle of left palm. Two sinuses were present in lower third flexor aspect of forearm. A large acute abscess extends from lower sinus backward over ulna and reaches to posterior surface above the elbow joint.

August 6, 1920. Operation. Professor Morison. Abscess in upper arm and forearm opened by long incision. Carious bone area size of sixpence, over external condyle of humerus. Pus burrowing from thumb to palm and up forearm in flexor sheath. Much dirty tuberculous-looking granulation removed from palmar synovial pouch and from a sinus extending deeply among flexor muscles to junction of middle and upper third of forearm. Sinus was opened up and tuberculous septic débris removed as far

as possible by dissection and Volkmann's spoon. All diseased area cleansed with dry gauze and spirit gauze and then "bipped." Long incision closed with bipped" silk sutures. Arm put up in plaster of Paris from finger tips to shoulder.

Bacteriological report on pus from acute abscess. Tubercle Bacilli detected by sedimentation test (few). Culture sterile.

August 10, 1920. Arm is much easier. Patient has been feeling better and has been out on balcony since yesterday.

August 13, 1920. Allowed up.

September 17, 1920, wound dressed first time—6 weeks after operation. Dressing dry with exception of one drop of moisture from thumb. Sutures removed. Wound in palm healed. Incision in thumb a linear wound, with a few granulations here and there. Forearm wound healed where incision was made. Two granulating areas where old sinuses were, one at upper end one-fourth inch by one-eighth, lower one the size of a split pea. On inner side of thumb is a small granulating area, also the size of a split pea.

The wound over dorsal ulnar aspect of upper arm and forearm healed except for 2 granulating areas over external condyle of humerus, size of split pea. The silk sutures had left small (pin-head size) granulating areas where they were removed. Dressed with "bipp." Arm put up as before in plaster of Paris from finger tips to shoulder.

October 6, 1920. Swelling developed in left iliac region. Marked impulse on coughing. Psoas abscess. Angular curvature dorsolumbar region—spinal caries. To go to bed on balcony and wear spinal jacket.

October 15, 1920. The abscess in iliopsoas sheath was opened by 6-inch, oblique, incision and about 1 pint of pus evacuated. The cavity was cleaned out with dry gauze, spirit and "bipp." The wound was completely closed.

Bacteriological report on pus. No tubercle bacilli detected. Culture—no growth.

October 21, 1920. Swelling on plantar surface of left foot which has broken down. Foments. A small tuberculous abscess also has burst in perineum.

October 29, 1920. Second dressing of arm. Absolutely dry except for a small granulating area on medial side of thumb—ulcer about size of coffee bean. "Bipped." Splint left off. Side (iliopsoas abscess) dressed. Perfectly dry and healed by first intention. Sutures removed. Spirit dressing.

November 6, 1920. Foot quite dry and healed.

November 20, 1920. Thumb healed. Complained of pain in back—nothing to be found.

December 13, 1920. Iliac wound has broken down for half inch on its surface and is discharging a little. Dressed with flavine.

January 6, 1921. Very little discharge from iliac wound. Patient looking fatter and better.

January 31, 1921. Thumb wound has broken down a little. Movement in fingers is improving.

March 7, 1921. Thumb healed. Iliac wound almost healed—just a little surface moisture.

This case is the most extraordinary one in all my surgical experience. The arm appeared to be in a hopeless mess at the time the operation was undertaken, and amputation through the upper arm suggested itself as the most reasonable course.

How wrong that would have been is evident now as the arm, though still carefully protected, is almost fully restored to its function.

Fig. 6 (at left). Roentgenogram, Case 8, taken January 4, 1921, 100 days after operation.

Fig. 7. Roentgenogram, Case 8, taken April 12, 1921, 206 days after operation.

Mr. Wade's introduction to the discussion on the "Treatment of Acute Pleural Empyema" encourages me to relate the case of a soldier who was admitted to the Northumberland War Hospital in 1916, with acute wound sepsis.

He was wildly delirious, and had to be restrained by straps in bed. While in this condition he developed acute pleural empyema. After repeated aspiration had failed to arrest the effusion I opened his chest widely, letting out more than a pint of pus, treated his pleura with the "bipp" method, and closed the large wound entirely with catgut sutures. The wound was smeared with "bipp" and owing to his mental condition no dressings were applied. This patient at once began to recover and his wound healed by "first intention." I have not dared to publish the case before as it seemed to me that it would only be regarded as too good to be true, or a lucky chance.

Bone Cavities

In the book previously mentioned (*loc. cit.* p. 28 and seq.) in reference to filling bone cavities with fat grafts I write: "No bone graft will live in a septic cavity or in the presence of irritating antiseptics. After proving that skin grafts could survive treatment by our method ("bipp") we adopted free fat grafts as best and most easily obtainable, and have now had so many successful cases that we feel justified in saying that recovery should be the rule, and an explanation of failure should be carefully sought for. . . .

"If there is any tension on the wound edges when the sutures are removed, fat appears at the

Fig. 8. Roentgenogram, Case 9, taken October 4, 1920, showing condition before operation.

Fig. 9. Roentgenogram, Case 9, taken January 11, 1921, 38 days after operation.

Fig. 10. Roentgenogram, Case 9, taken June 20, 1921, 105 days after operation.

bottom and healing is much delayed, though the grafts have never in our experience been extruded. . . .

"After months of daily dressing and discharging these cases may be expected to heal in a few weeks. It is interesting to watch in X-ray pictures replacement of the fat by bone."

Three more years of experience have confirmed all of this, and now I have overwhelming evidence in support to give you. The chief difference between then and now is that years instead of months have elapsed since the wound and fracture which resulted in a bone cavity, the patients are not so physically fit and are more often in a hopeless frame of mind after undergoing a series of operations which have failed to cure them. It was impossible for me to offer statistics from the Northumberland War Hospital in support of my views, because the patients were kept there for as short a time as possible, and after leaving hospital many of them could not be traced. Possibly for this reason so little importance has been attached to my work that in the latest book on the *Orthopædic Surgery of Injuries*, edited by Sir Robert Jones and published this year, Mr. Elmslie who has written the article on bone cavities, excellent in every respect except in the treatment of them, never mentions fat grafts though he approves of the "bipp" method of treatment of the cavity.[1] Where the cavity cannot be obliterated by flattening out its walls, he uses a muscle graft and *drains*.

For any cavity which can be made shallow enough without seriously weakening the bone, all are agreed that this method is easiest and best, but in the most serious cases nothing short of filling the cavity with some sort of graft will suffice. In the great majority of my cases, multiple fat grafts have been used, in some muscle and fat, in others muscle alone. I have not used muscle which could perform its proper function for this purpose.

Since working at the War Pensions Hospital I have been able to follow up all of my cases, and am now able to say definitely that there has been no failure, and that no bone cavity has been discharged from our supervision until healed, and after a test of 10 days' exposure to radiant heat has proved that it is unlikely to break down again.

Omitting any reference to the minor cases cured by the removal of sequestra, chiseling

[1] At the British Medical Demonstration in July, 1921, Mr. Elmslie stated that his article was written before my book was published.

away the walls, application of "bipp," and immediate closure by interrupted sutures. I have notes of 20 cases, operated upon during the last year, of large bone cavities, all but one treated by grafts. One of these cases it will be noted dates back as far as 1914, and all of them had undergone multiple operations which had failed to cure the discharging sinus for which they were admitted.

The fact may be recognized that radical operation in these cases may be a difficult and prolonged one, and it always requires patient, persistent perseverance. A large incision is essential to allow of proper access and it is important to remove sufficient of the sclerosed bone covering the cavity to *see* every part of it. The most difficult cases are those in which the entire bone has been perforated by the missile. A striking example of this occurred to me in the femur. There was a long discharging sinus on the front of the thigh in the center of a large scar, and there was a *healed* scar opposite to this on the *back* of the thigh. A sequestrum was removed from a pocket in the *back* of the thigh bone after 2 hours' hard work. It is very easy to miss a sequestrum lying either in the bone or soft parts on the side opposite to the discharging sinus and nearer to the healed scar.

A skilled assistant should take out every particle of bone as it is separated, otherwise healing of the wound may be delayed until it is taken out or extruded. When possible the operation should be done with a tourniquet to allow of satisfactory inspection and to prevent the serious loss of blood which may follow one hour or more of operating. If there is any doubt felt as to *seeing* the whole cavity, aided by a bull's eye light, I pack it with "bipped" gauze, close the incision by interrupted sutures over this, and at the end of 2 weeks dress the wound, take out the sutures, reopen it, remove the gauze, fill the cavity with fat grafts, and resuture, if there is no sign of wound infection.

The fat I prefer is taken from the outer side of the thigh and overlying the fascia lata. It is more fibrous and less greasy than that from the abdominal wall.

There must still be hundreds of men incapacitated by chronic bone sinuses, and the proper treatment of them is a matter of importance to the country. Their health and working capacity are undergoing gradual deterioration and many of them become seriously ill from "flares up" from time to time. This is my reason for placing such great emphasis upon the subject in this address.

Fig. 11. Roentgenogram, Case 10, taken September 29, 1920, before operation.

CASE 4. Pens. L., age 33. Gunshot wound left leg. Fractured tibia. Wounded August 26, 1918, by a machine-gun bullet, when going over the top. Bullet went through both legs. He lay for 4 days before being picked up—got caught in barbed wire when crawling in. The right leg healed at once—bullet went through without touching bone. Four operations had been done on left leg before admission.

On admission May 6, 1920, there was a scar on outer and inner aspect middle of left leg. Some discharge from inner wound. X-ray showed large cavity in tibia with sequestrum.

May 29, 1920. Operation. Mr. Cuff. Scar and sinus excised by 4-inch incision. Edges of cavity rounded off with chisel. Small sequestrum (size of pea) removed. Cavity scraped with spoon, "bipped," and wound closed with "bipped" silk.

June 22, 1920. Second operation. Mr. Cuff. Edges of wound excised, cavity thoroughly scraped and smoothed off. Scrubbed out with gauze, spirit and "bipp" rubbed in. Small pieces of fat were removed from abdominal wall and cavity filled with same. A long flap, 7 inches by 2 inches, was cut on outer surface of wound and pulled over cavity and secured *in situ* with "bipped" silk.

July 13, 1920. Dressed first time—21 days after operation. Good deal of discharge. Fat exposed. Looking well—no pus.

September 6, 1920. Fat still exposed. Wound now dry.

October 6, 1920. Wound still dry—diminishing in size. Fat showing as before.

Fig. 12. Roentgenogram, Case 11, before operation.

Fig. 13. Roentgenogram, Case 11, taken April 4, 1921, 152 days after operation.

Fig. 14. Roentgenogram, Case 11, taken July 11, 1921, 250 days after operation.

December 6, 1920. Fat lying unchanged at bottom of gap.

January 10, 1921. Now an elliptical granulating wound, 1 inch long by ⅛ inch wide at lower end of incision. Fat still exposed at bottom of it. Closing in.

Fig. 15 (at left). Condition, Case 12, before operation.
Fig. 16. Condition, Case 12, after operation.

February 7, 1921. Fat still showing.

March 7, 1921. Fat now covered by granulations. Dressed "bipp."

March 21, 1921. Closing in quickly.

April 18, 1921. Healed.

June 13, 1921. Finished radiant heat treatment. Soundly healed.

Summary. Pens. L., age 33, wounded August 18, 1918. Fractured tibia. Five previous operations. Last operations (by Mr. Cuff). May 29, 1920, first operation; June 22, 1920, second. Healed April 18, 1921—10 months.

Case 5. Pens. W. Gunshot wound of left thigh; compound fracture femur; amputation left forearm. Wounded September 7, 1916, by shrapnel. The wound was healed from November, 1917, until January, 1918, when it broke down again. Since then he has had 10 operations—he cannot remember how many he had before.

Notes from English Hospital. February 21, 1919. Shell wounds lower third left thigh with discharging sinus, marked œdema of this area, also of knee joint in which there is slight fluctuation present. Amputation of left forearm 2 inches below elbow joint—healed.

March 23, 1919. X-ray shows large cavity in femur. Operation: Cavity scraped, no sequestrum present.

May 16, 1919. Operation: wound opened up freely, abscess cleaned out, much bone chiseled away, abscess in medulla opened, chiseling bone cleared—flavine; bone chips placed in cavity.

May 26, 1919, better—cavity rather septic.

June 2, 1919. Cleaned. Transferred.

July 4, 1920. Returned to Central Hospital for further treatment. Diseased bone.

September 29, 1919. Operation. Large cavity in lower end of femur opened up. Sequestrectomy. Sutured.

November 18, 1919. Discharges offensive and purulent. X-ray showed more sequestra.

Fig. 17. Condition, Case 13, before operation.

Fig. 18 (at left). Roentgenogram, Case 14, taken November 17, 1920, before operation.

Fig. 19. Case 15, taken November 17, 1920, before operation.

November 21, 1921. "Bipp" and olive oil in equal parts.

January 29, 1920. For operation. Transferred.

May, 1920. Operation: sequestrectomy.

June 15, 1920. Operation. Professor Morison. Scar and sinus on outer aspect lower third of left thigh excised. Muscles incised down to bone and retracted. Cloaca enlarged with gouge and larger gutter cavity (4 inches) exposed. This was cleaned out with gouge and spoon, and dry gauze, swabbed with spirit, and "bipped." The incision was carried up for another 3 inches and four plugs of subcutaneous fat cut, and cavity filled with same. The muscles were then sutured with catgut.

A large flap was cut by curving lower part of incision down, out and up, pulling over wound, and suturing with "bipped" silk.

July 2, 1920. Dressed first time. Not healed. Flap dusky. Not much discharge.

July 16, 1920. Flap sloughed and fat exposed.

October 22, 1920. Still a large unhealed area where skin flap sloughed and a good deal of discharge. Dressed flavine.

November 6, 1920. Much less discharge. Wound probed —bare bone could *not* be felt. No fat had ever come out.

January 10, 1921. Little pus coming, from surface apparently, at lower end of wound. Rest of wound healed.

January 31, 1921. Still a good deal of pus could be squeezed up from under skin at lower end of wound.

February 14, 1921. Lower end of wound opened up under local anæsthetic, and a quantity of pus and a small piece of bone evacuated.

February 27, 1921. Very little discharge from lower end of wound.

March 7, 1921. Very nearly healed. Hardly any discharge on 3 days' dressing.

March 21, 1921. Healed. For radiant heat treatment.

April 4, 1921. Finished radiant heat treatment. Soundly healed. For discharge.

Summary. Pens. W., age 21. Wounded September 7, 1916. Large bone cavity in femur. Many previous operations—more than ten. Last operation July 2, 1920 (Professor Morison)—cavity filled with fat grafts. Skin flap sloughed. Healed March 21, 1921—8 months.

Case 6. Pens. J. E. S., age 21. Gunshot wound right thigh with fractured femur. Bullet in liver. Wounded October 9, 1918, by a machine-gun bullet when going over the top. A bullet was removed from his liver at a C. C. S. Has had 10 operations on femur. X-ray shows cavity in femur.

Note from English Hospital October 23, 1919. "Patient wearing caliper splint ½ inch extra sole to boot. Long linear scar along lateral surface of right femur. Healed except for persistent sinus in middle of scar. Complete ankylosis of knee joint. X-ray shows old fracture of femur with cavity in bone and sequestrum."

August 31, 1920, Operation by Professor Morison. Tourniquet used. Longitudinal incision, 12 inches in length with sinuses in middle part of it. Cavity in bone exposed and a considerable amount of unhealthy granulation tissue found lying in lowermost part of medulla. Cloaca enlarged and all overlying bone tissue removed. Sclerotic tissue chiseled away. Several tracks in bone opened up. The bone cavity was found to open on to popliteal surface of femur. A large graft of the vastus externus muscle was placed in the cavity after the latter had been cleaned by "bipp" technique. Tourniquet removed. Wounds sutured with catgut. "Bipped" silk for skin. Put up in plaster-of-Paris.

September 1, 1920. Discharge through twice in night. Pickled with spirit and boric powder.

September 4, 1920. Been running temperature—101.8°; 100.2°; 101.8°; 99.8;° 100°; 99.8°. Discharge through again in night. No pain. Feels better.

September 6, 1921. Still running temperatures so dressed. Some moisture (about 2 drams) on dressing. Wound in center has opened up for ¼ inch, otherwise no redness, no œdema, and no evidence of anything wrong. Spirit dressing.

September 13, 1921. Being dressed daily. Little serum. Looking well—wound not opening up. Patient out on balcony.

October 1, 1920. Patient complained of abdominal pain, temperature 101.6°.

Fig. 20. Roentgenogram, Case 16, taken November 9, 1920, before operation.

Fig. 21. Roentgenogram, Case 16, taken April 12, 1921, 68 days after operation.

Fig. 22. Roentgenogram, Case 16, taken April 12, 1921, 68 days after operation.

Opening ½ inch by ¼ inch in center of wound of oval shape with sinus in middle of it, from which there had been about ½ dram discharge.

October 3, 1920. Temperature 99°.

October 4, 1920. Temperature normal.

October 18, 1920. Wound appeared superficial. To be dressed with flavine and castor oil.

October 30, 1920. Healed.

December 13, 1920. Has had 14 days' radiant heat treatment. Soundly healed.

Summary. Pens. J. E. S., age 21. Wounded October 9, 1918. Fractured femur. Large cavity. 10 previous operations. Last operation (Professor Morison) August 31, 1920. Healed October 30, 1920—2 months.

Case 7. Pens. G., age 23. Gunshot wound left thigh. Wounded April 27, 1915, by a rifle bullet. The bullet went right through fracturing the femur. He had 6 operations, but the outer wound has never healed. There is an operation incision underneath the thigh which, he says, also keeps breaking down and discharging.

September 16, 1920. Operation. Professor Morison. Sinus probed and bare bone felt. Elliptical incision was made 8 inches long, excising scar, down to bone. A sequestrum was found while the unhealthy granulations were being cut away. The periosteum was peeled back from the bone. The whole wound was "bipped." Some dead bone and unhealthy tissue were removed and the bone cavity exposed—about the size of a sparrow's egg. The edges of cavity were chiseled away and some necrotic bone removed. Three sequestra were found in the depths of cavity. When chiseling was completed the cavity was the size of a bantam's egg. A probe passed through the under sinus did not touch bone. The sinus was enlarged but no bone was found. The bone cavity was cleaned with spirit and "bipped." Packed with strips of "bipped" gauze—to be left for a month and then fat grafted.

Relief incision made 2 inches outside operation wound —of same length and parallel to it, and bridge of skin between undermined to allow closure over gauze in cavity without tension. Sutured with "bipped" silk. Edges of tension incision on each side sutured with "bipped" silk, to muscle fascia to diminish raw surface. Bridge of skin scored. Dressed strips of oiled silk and dry gauze. Small under sinus "bipped."

October 15, 1920. Second operation. Professor Morison. Wound, which was healed, opened up, and gauze pack

Fig. 23 (at left). Drawing, Case 17, showing condition before operation.

Fig. 28. Drawing showing condition in Case 20 before operation.

Fig. 24 (at left). Roentgenogram, Case 18, taken March 15, 1921, before operation.

Fig. 25. Roentgenogram, Case 18, taken July 12, 1921, 103 days after operation.

Fig. 26 (at left). Roentgenogram, Case 19, taken March 29, 1921, before operation.

Fig. 27. Same as Fig. 26.

removed with difficulty, as the gauze was infiltrated by granulation tissue; cavity was scraped out gently with a sharp spoon. No sign of sepsis present. Cavity was cleaned with spirit and "bipped." Incision about 8 inches long was made on right thigh and 4 pieces of fat overlying fascia lata removed from this and placed in cavity in left femur. The wound was completely closed by interrupted sutures of "bipped" silk. Whole surface "bipped." Incision on right thigh sutured. No splints.

November 6, 1920. First dressing since second operation (3 weeks). The wound over cavity all dry and whole—healed by first intention. Tension incision clean and granulating—the whole length of incision varying in width from ¼ inch to ½ inch. The skin gradually covering over at edges. Wound dressed with oiled silk and saline, after being washed with spirit.

December 4, 1920. Some inflammatory swelling in middle of scar—to be fomented.

December 6, 1920. Abscess burst. A very little blood-stained pus evacuated. "Bipp" dressing.

December 8, 1920. Still a few drops of discharge (pus mixed with "bipp").

December 13, 1920. Appears to be soundly healed.

January 24, 1921. Small discharging sinus in middle of scar over bone cavity—where abscess formed and opened.

February 7, 1921. No discharge but not quite soundly healed. Flavine.

February 14, 1921. Healed. To have radiant heat treatment.

March 14, 1921. Has had radiant heat treatment for a month. Soundly healed—never broke down under it.

Summary. Pens. G., age 23. Wounded April 27, 1915. Fractured femur. Large cavity. 6 previous operations—never healed. Final operations (Professor Morison): First stage, September 16, 1920; cavity cleaned with "bipp" technique; second stage, October 15, 1920; wound healed over "bipped" gauze. Opened up. Cavity filled with fat grafts. November 6, 1920. First dressing (3 weeks). Wound over cavity healed by first intention, but broke down in center later (December 4, 1920). February 14, 1921, soundly healed—4 months.

CASE 8. Pens. T. S., age 25. Gunshot wound left leg. Wounded October 4, 1918, by a bullet, near St. Quentin. Has had 7 operations—the most recent on September 2, 1920. Never healed.

Notes, C. C. S. October 4, 1918. Entrance wound about middle of inner side left leg. Exit in front of leg (fracture). Redressed back splint. French Hospital: leg swollen and tender (wound excised).

October 7, 1918. First operation. P. drain. Wound enlarged and fragments of tibia removed.

October 10, 1918, Scotch Hospital: Lacerated through-and-through wound mid-shaft of tibia (left) very dirty, a good deal of inflammation.

October 16, 1918, X-ray report "Comminution and partial destruction of middle of shaft of tibia."

October 30, 1920. Patient greatly improved. Wound has been doing well on Carrel Dakin treatment but there seems to be a pocket of pus anteriorly to be opened up soon.

November 7, 1918. Second operation. Wound completely opened up and extended.

December 5, 1918. Third operation: Opening over œdematous area below knee. Pus evacuated and several pieces of dead bone removed from a round area. Carrel Dakin treatment.

December 14, 1918. Fourth operation: Abscess opened and pus evacuated.

December 27, 1918. Wounds clean and healing slowly.

May 25, 1919. Scotch Hospital: Small wound middle of shaft of tibia. Complete fracture of same; wound not dry. ½ inch shortening.

June 26, 1919. Fifth operation: Sequestrectomy. Attempt to close cavity. Sinus excised and bone cavity

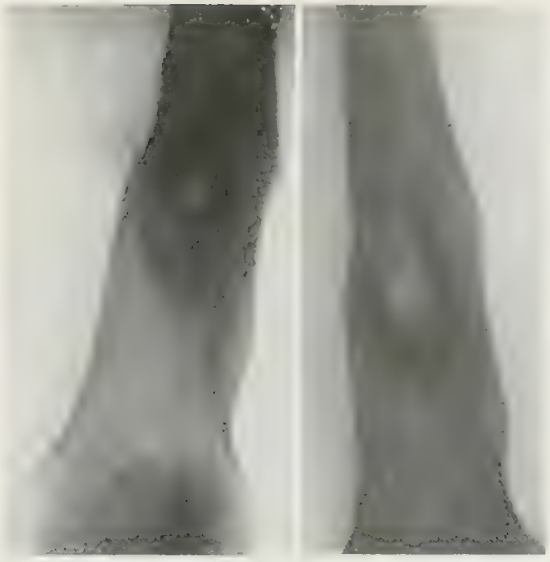

Fig. 29 (at left). Roentgenogram, Case 21, before operation.

Fig. 30. Roentgenogram, Case 21, 49 days after operation.

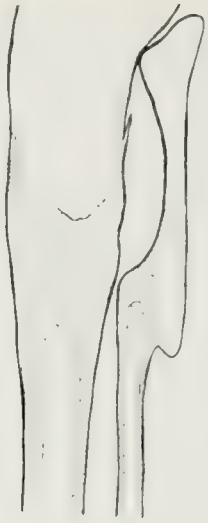

Fig. 31. Drawing showing condition in Case 22.

cleared of sequestra (2 present). Cavity scraped, incised. Pure carbolic. Soft parts sewn across.

July 10, 1919. Wound broke down rather badly—now healing nicely.

August 20, 1919. Massage. No nerve lesion. Bone union firm. Still scabbing at wounds.

September 17, 1917. Anterior tibial nerve interfered with by scar. Sinus over tibia. No bare bone felt.

November 15, 1919. Sixth operation: Excising scar down to tibia. Indolent granulations and sequestra removed from tibia and overhanging edges of bone chiseled away. Healthy bone tissue and skin apposed without tension.

November 20, 1916. Skin in poor condition, retracted from wound.

War Pensions Hospital N. C. September 1, 1920. Raw area about size of a shilling on middle of anterior surface of left leg, discharging pus. Sinus—probe goes about 1 inch into tibia.

September 2, 1920. Seventh operation: Sinus excised. Cloaca cleaned out and greatly enlarged, overhanging bone being removed with granulation tissue. Cavity opened into posterior tibial region. Cloaca "bipped." Skin sutured over and allowed partially to obliterate cavity.

September 18 1920, dressed first time. In lower two thirds of incision skin edges approximated. Upper two-thirds an elliptical gap 2 inches by 1 inch. The cavity was clean and lined with healthy granulation tissue. Packed with "bipped" gauze.

September 24, 1920, operation by Professor Morison. Old scar excised by elliptical incision 6 inches long exposing the medial portion of tibialis anticus muscle. Two counter incisions, 1½ inches away from original incision on the median and lateral aspect of the calf. These incisions were about 8 inches in length. Cavity in the bone cleaned out with spirit and "bipp." An incision made on outer surface left thigh and 4 masses of fat removed and placed in cavity in tibia to fill it up. Free medial edge of periosteum was sutured to free edge of tibialis anticus muscle by figure-of-eight suture to hold fat in position. Skin sutured with interrupted silkworm-gut sutures and the skin edges approximated with fine catgut.

Medial counter incision partially closed without tension by means of interrupted catgut sutures between the middle of the deep fascia and the medial skin edge. Two interrupted sutures also put between the two skin edges. Same procedure followed with lateral counter incision. Cavity and fat graft covered by two skin flaps attached at both ends. Skin of flaps scored. Wound dressed with "bipp," dry gauze, and boric powder.

October 15, 1920. Dressed first time—3 weeks.

Very little discharge—not more than ½ dram. Middle line wound separated at upper end about ¼ inch and fat graft was showing lying at the bottom of it. Sutures removed. Relief incisions healed except for one or two small granulating areas—about size split peas. "Re-bipped."

Incision on thigh from which fat was taken soundly healed and sutures absorbed.

October 23, 1920. Dressed. Half dram of discharge coming from fat grafted area. Fat still showing at bottom of wound and lower part of wound had given way in middle to extent of split pea showing fat there also. Dressed with flavine and castor oil.

November 20, 1920. Wound quite dry. Still two small areas in center of scar unhealed.

December 4, 1920. Wound dry. Healing—two small areas less.

March 7, 1921. Still two very small, quite dry, unhealed areas.

April 18, 1921. Healed.

June 13, 1921. Has finished radiant heat treatment. Soundly healed.

Summary. Pens. T. S., age 25. Wounded October 4, 1918. Fractured tibia. 7 previous operations. Last operation (Professor Morison) September 24, 1920—cavity filled with fat grafts. Healed April 18, 1921—6½ months.

Case 9. Pens. B, age 23. Unhealed sinus left leg. Wounded November 10, 1918, by shrapnel. Has had 12 operations on his left leg, but it has never been healed.

At one operation 12 pieces of metal were removed—this was in June, 1919. The same month another operation was done at a Naval Hospital and a fat graft was taken from his abdomen to fill the cavity. No "bipp" was used and the fat suppurated out.

June 29, 1920. War Pension's Hospital Newcastle. Excision of sinus—large quantity of old "bipp" scraped from large cavity in tibia. Cavity cleaned out—for later operation. Patient was temporarily discharged—returned to hospital on September 27, 1920. There is still a discharging sinus below the left knee and a good deal of scar tissue round it.

October 8, 1920. Operation. Professor Morison. Tourniquet applied. Probe passed into sinus and bare bone was felt. The scar was excised by elliptical horizontal and longitudinal incisions and large cavity in the tibia, the size of a walnut, was immediately exposed. The periosteum was peeled back, and the whole surface rubbed with "bipp." The cavity was scraped out with a sharp spoon, and the infected bone chiseled away and the cloaca enlarged. The cavity was now very close to the cartilage of the joint, and about the size of a hen's egg. The bone surrounding cavity was much sclerosed. The cavity and surrounding skin were cleaned after "bipp" technique. The skin edges were undermined. Two longitudinal relief incisions, 4 inches long, were made on each side of the wound and the skin between these and the wound incisions, 2 inches wide, undermined. The whole flaps of skin between the anterior relief incision and the original incisions were turned back. An incision was made on the outer surface of the left thigh and 8 large pieces of fat were removed and placed in the cavity in the tibia. The thickened periosteum, which was peeled off the tibia, was sutured, over the fat to keep it in position. Catgut sutures and 2 interrupted catgut sutures, with figure-of-eight. The sinus flap was sutured into position over this with "bipped" silk and fishing gut. The skin edges of both relief incisions were sutured to the muscle fascia to secure as much closing as possible. Skin scored. Boric powder. Two Gooch splints. The incision on thigh was sutured with continuous suture of catgut.

October 11, 1920. There was some discharge through dressings. Pickled on outside with spirit, sprinkled with boric powder and wool dressing bandaged on.

October 29, 1920. Dressed for first time—3 weeks after operation. About one-half ounce of purulent hæmorrhagic discharge was found on dressing. The upper end of the flap had given way for three-fourths inch transversely and had separated for about one-half inch in vertical line exposing fat. The sutures were removed. Dressed with flavine and castor oil.

The wound on thigh has healed.

Bacteriological report on discharge. Large number of colonies of staphylococcus aureus found.

November 6, 1920. Second dressing. About 1 dram of pus was found on dressing. No more separation of flap. The fat remained undisturbed and in position. Dressed with flavine.

November 12, 1920. Third dressing. About 2 drams of purulent discharge were found on dressing, chiefly from tension incision wounds. Granulation tissue was a little exuberant. No fat has extruded. Cavity filled with "bipp." Granulations to be dressed daily with red wash.

November 20, 1920. Looking well. Healing. Some pus (about a dram), dressed with flavine.

November 27, 1920. Cavity healing in—to be filled with "bipp" over exposed fat.

November 29, 1920. Cavity healing in rapidly—refilled with "bipp." Granulations on relief scars now level with skin and healing well.

Fig. 32. Roentgenogram, Case 23, taken August 2, 1921, 25 days after operation.

December 21, 1920. Cavity on surface now size of a pea—no fat can now be seen.

January 19, 1921. Cavity almost filled in.

January 24, 1921. Dry crust over cavity.

January 31, 1921. Still some discharge from incision at inner side.

February 14, 1921. Almost healed. Very little discharge. (Patient has been kept in bed most of the day lately.)

February 21, 1921. Just a pin head spot remains unhealed.

February 25, 1921. Healed.

March 30, 1921. Patient sent for radiant heat treatment. All scars broke down under it. To be dressed with flavine and to be kept in bed.

Bacteriological report on discharge. Staphylococcus aureus present but not so numerous as on occasion of last examination.

April 4, 1921. Healing in rapidly. "Bipp."

April 28, 1921. Healed.

June 13, 1921. Has had radiant heat treatment again. Never broke down. Soundly healed.

Summary. Pens. B., age 23, wounded November 10, 1918, fracture of tibia. Twelve previous operations—at one fat grafts were used but no "bipp" and the fat suppurated out. Final operation for bone cavity October 8, 1920 (Professor Morison); cavity "bipped" and fat grafted. Some infection of wound but insufficient to disturb exposed fat grafts.

February 25, 1921. Healed.

March 30, 1921. Radiant heat. Scars broke down.

April 28, 1921. Healed—6 months.

Fig. 33. Roentgenogram of jaw 6 months after fat-grafting operation.

Fig. 34. Roentgenogram of same patient as in Figure 33. 9 months after operation.

June 13, 1921. Finished radiant heat treatment. Soundly healed.

Case 10. Pens. D., age 43. Gunshot wound right shoulder. Wounded May, 1918, near Arras. Has had three operations—the first in June, 1918, for the removal of shrapnel; the second on September 20, 1918, sequestrectomy; and the third also sequestrectomy, but he cannot remember the date. In February, 1920, the shoulder healed for the first time, but it broke down again 5 months later, May, 1920, and has been discharging since.

October 15, 1920. X-ray shows old fracture of humerus, with absence of head of bone. Healed linear scar along spine of right scapula. Healed scar on anterior surface of right deltoid region with freely discharging sinus in middle. Healed scars on lateral surface of whole upper arm; also round elbow joint on posterior medial surface. Movements of wrist and fingers impaired. Elbow ankylosed at angle of 110. Scapula movements impaired. Slight painful movement at shoulder.

October 21, 1920. Operation. Professor Morison. The sinus over the head of the humerus was excised. A large cavity was found in the ankylosed head of the humerus. The cavity extended a considerable distance down the shaft and upward underneath the clavicle to the scar on the back of the scapula. A large amount of dense fibrous tissue was removed also overhanging the bone edges. Pus was found to be issuing from the cavity in the bone, which tracked through scapula into supraspinous fossa. This cavity was cleared and the whole wound treated with "bipp" technique. A square-shaped skin flap was reflected over the deltoid. Two large flaps of deltoid muscle were detached from the humerus at its insertion; the inner flap was turned up into upper cavity and the second down into lower cavity. These were "bipped" and sutured with numerous catgut sutures into the cavity which was completely obliterated. The skin was sutured with interrupted "bipped" silk, "bipped" and dressed with dry gauze impregnated with sterile boric powder. A large woollen pad was put in the axilla, and arm bandaged to side.

October 28, 1920. Patient has a strong smell of iodoform. There is a faint blue line round teeth—"bipp" poisoning.

November 12, 1920. Dressed first time—3 weeks after operation. The transverse portion of the wound has healed. In the middle of the vertical portion is an area the size of a split pea, which is not healed. "Bipped." At upper end over a thin scar were 3 very small granulating areas. "Bipped." No discharge was found on dressings—a little paraffin had been exuded from the "bipp" which was quite dry. Boric powder. Dry gauze. Arm put up against side as before.

March 7, 1920. Not quite healed—a very little discharge.

April 4, 1921. A probe dipped in pure carbolic acid was passed right through both sinuses. No bone was felt. Track to be squirted through with Beck's paste.

July 4, 1921. The two sinuses still communicate. To be washed through with peroxide.

Summary. Pens. D., age 43, wounded May, 1918. Large bone cavity in upper end of ankylosed humerus, cured by muscle grafts. The case is shown specially to illustrate the difficulty of treating shoulder wounds, and partly because this patient is the only one we have had here showing "bipp" poisoning in the first degree. Operated upon October 21, 1920.

October 28, 1920, "bipp" absorption. Not at all ill, but blue line round teeth.

April 28, 1921. Sinuses are still present in soft parts but bone cavity healed long ago.

July 4, 1921. Sinuses not yet healed.

Case 11. Pens. B., age 43. Gunshot wound right knee. Wounded June 2, 1915, at Ypres. Patient has had 5 operations. At one of these fat grafts were employed but no "bipp" was used and they suppurated out.

On admission, September 2, 1920, sinus was present in upper end of tibia below insertion of ligamentum patellæ and reaches bone.

September 3, 1920. Acute lymphangitis of thigh developed and operation was therefore postponed.

September 8, 1920. Acute abscess incised on antero-internal surface of the middle of the right thigh. About 2 ounces of thick pus evacuated.

September 22, 1920. Radiant heat was applied to right leg.

September 25, 1920. Bacteriological report on pus from bone cavity: Diphtheroid bacillus present, resembling in microscopic staining and cultural aspect the diphtheria bacillus but *non-pathogenic*.

October 11, 1920. Bacteriological report. A few diphtheroid bacilli present still. Large number of staphylococci found.

November 2, 1920. Operation. Professor Morison. Tourniquet applied. A semilunar incision with convexity lying medially was made. The sinus was excised and the whole wound treated with "bipp" technique. The cloaca was enlarged and very vascular bone removed, also two metallic bodies. Tourniquet removed. "Bipp." Cavity filled with 5 large and 2 small pieces of fat taken from the left thigh. Wound completely closed with interrupted silkworm-gut sutures. "Bipp." Skin scored. The wound was dressed with dry gauze and boric powder. No splint was applied. The incision on the left thigh was sutured with silkworm gut.

Bacteriological report on discharge (taken before commencement of operation): diphtheroid bacilli still present, streptococcus and staphylococci also found.

November 23, 1920. Dressed for first time after operation—3 weeks. Skin flap has partially sloughed, exposing a circular area over the cavity, about the size of a shilling piece. Fat exposed. No clinical evidence of infection. Very little discharge. The lower part of wound has healed. Dressed with flavine.

November 29, 1920. Thigh (from which fat grafts were taken) has healed. Fat in cavity still exposed. Healing in from edges. No pus.

December 12, 1920. Under local anæsthesia, an incision 2½ inches long, curved on the inner side of the sinus, was cut down to the tibia, with a view to increasing the blood supply to a proposed flap that was to be cut for covering over the exposed fat.

December 20, 1920. Operation. Flap cut with pedicle above and drawn over the exposed fat and sutured in position. Tension incisions were made and the exposed area brought together as closely as possible with catgut sutures.

December 27, 1920. Patient thought the bandage had slipped, so dressing was changed. The flap had given a little at the upper end—an area the size of a little finger nail. The whole flap was living and looking well. "Rebipped."

January 10, 1921. Wound is being dressed every second day. There is little discharge. Wound is granulating satisfactorily. To be dressed once a week.

January 31, 1921. Still a little serum (one drop) at upper and outer angle of flap. "Bipp." To be allowed up on crutches.

February 7, 1921. There is still a very little serum on the dressing.

March 14, 1921. Wound very nearly healed.

June 13, 1921. Wound not healed yet. Nothing could be felt with probe. To be probed when dressed (once weekly) with pure carbolic.

July 18, 1921. Wound not yet healed. Very little discharge.

Summary. Pens. B., age 43. Wounded June 2, 1915. Fractured tibia. Six operations since. Fat graft used at one of them but no "bipp" and fat suppurated out. Final operation for bone cavity November 2, 1920 (Professor Morison). Skin flap partially sloughed exposing fat. Still not quite healed. Area of dermatitis. This man's skin is intolerant of iodoform or flavine.

Case 12. Pens. C., age 29. Gunshot wound of right thigh. Wounded April 6, 1918, by shrapnel. The right femur was fractured and in consequence there is 2-inch shortening of that bone. The bullet passed right through the thigh and since that date the anterior (entrance) wound has never been sound—occasionally healing for a few weeks and then breaking down and discharging copiously for a prolonged period. He has undergone 8 operations—the most recent in September, 1919. Owing to an accident the damaged bone was refractured last year but united without much trouble.

Fig. 35 (at left). Photograph of Case 24, 1 year and 5 months after operation.

Fig. 36. Roentgenogram, Case 24, 1 year and 5 months after operation.

On admission, November 1, 1920, there was a discharging sinus on the front of the right thigh, extending downward and backward to bone, admitting probe for 3 inches. The posterior wound was healed.

November 15, 1920. Operation. Professor Morison. A probe was passed into the sinus and bone felt. The sinus was excised with elliptical incision, 6 inches long. The periosteum was peeled back, and a cavity, the size of a walnut, exposed. It was cleaned with spirit. "Bipped." The edges of the cavity were chiseled away—it was endeavored to broaden out the hole in order to make as shallow a gutter as possible. It was impossible to use a tourniquet as the lesion was so high up on the thigh. The hæmorrhage was arrested by hot saline mops and Lane's clips. The whole surface was again cleaned, spirit and "bipped." A perforation at the base of the cavity, extending through to the back of the thigh, was plugged with fat. A muscle and scar pedicled flap was sutured down to fill the cavity. The vasti muscles were sutured over this with figure-of-eight suture of thick catgut. The skin was closed with "bipped" silk suture. No splints were applied.

December 10, 1920. Dressed—first time—3 weeks. All healed except one small granulating area in center of the wound, the size of a split pea. The sutures at middle and lower end had cut in a little. The sutures were removed. "Bipp." Boric powder.

Bacteriological report. Staphylococcus present in specimen.

January 6, 1921. Returned from Christmas leave. Unhealed superficial small area in center of scar still discharging slightly. Flavine.

January 31, 1921. One drop of discharge. The granulating area is now the size of a pin head.

February 14, 1921. Still an unhealed area present in center of scar. To have radiant heat through his dressings, but to report at once if the wound "flares up."

March 14, 1921. Still one very small superficial discharging area in scar.

April 18, 1921. Healed.

April 28, 1921. Wound has broken down again. Probed with pure carbolic—no bare bone felt.

June 13, 1921. Wound heals and breaks down alternately. Probe passed down very small track in soft parts. No bone felt.

July 18, 1921. Still a small sinus, which is filling in from the bottom.

Summary. Pens. C., age 29, wounded April 16, 1918. Fractured femur. Eight previous operations. Final operation for bone cavity. November 15, 1920. Professor Morison. The wound has alternately healed and broken down again. Was healed on April 18, 1921, but broke down superficially 8 days later. No bare bone can be felt.

CASE 13. Pens. McB., age 33. Gunshot wound left thigh. Wounded December 8, 1916, by a bullet in the left thigh, the femur being fractured. The anterior and posterior wounds have alternately healed and broken down, but have never both been sound at the same time. He has had 12 operations—the most recent in March, 1920.

On admission, November 1, 1920, there was no shortening and the bone was united in good position. The wound was a through-and-through one, with the exit on the posterior aspect of the limb. There was a small depressed ulceration in the middle of the thigh from the center of which a sinus passed directly backward to the femur, which felt as though it were stripped of periosteum, but no cavity or sequestrum was palpable.

November 19, 1920. Bacteriological report on pus from wound *before* operation: Gram negative bacilli present. Bacillus coli. No staphylococcus nor streptococcus found.

November 19, 1920. Operation. Professor Morison. The cavity in the femur was exposed and enlarged. A small perforation passing backward through the bone was enlarged and 3 sequestra removed. The cavity where the sequestra were lying was excavated and the bony opening into it enlarged. This was cleaned out with spirit and the whole "bipped." Four small fat grafts were placed in the posterior cavity and a pedicled flap of quadriceps was turned down to fill the larger part and sutured into position. The wound was sutured with catgut. To be dressed in 3 weeks.

December 10, 1920. Dressed first time—21 days. Two apparently superficial granulating areas (the size of split pea), were present between the sutures at the junction of middle and lower thirds of wound. There was no discharge from either of these and a layer of "bipp" was seen lying all along the wound. "Bipp" dressing. The incision from which the fat was taken was all healed except that the second stitch at the upper end had cut in slightly. "Bipp."

January 6, 1921. Returned from Christmas leave. Soundly healed. For radiant heat.

January 24, 1921. Finished radiant heat treatment. Soundly healed. For discharge.

Summary. Wounded December 8, 1916. Fractured femur. Twelve previous operations. Last operation November 19, 1920. Professor Morison.

January 6, 1921, returned from Christmas leave all healed—7 weeks and 5 days.

CASE 14. Officer, age 24. Gunshot wound right arm. Wounded April 9, 1917. The arm was healed from April, 1919, until July, 1920. Before that it had alternately healed and broken down—never healed for more than 3 weeks at a time. In June, 1920, the arm ached and swelled and an acute abscess formed. He has had 8 operations.

July 8, 1920. X-ray shows old fracture humerus—possible cavity.

November 19, 1920. Operation. Professor Morison. A discharging sinus over upper end of humerus was excised. The upper end of the humerus was exposed. There was a sinus communicating with the medullary canal. The sclerosed anterior wall of the bone was removed for a considerable distance exposing a large cavity. A long strip of the anterior edge of the deltoid muscle was detached from its insertion and curved up and sutured into the upper cavity, being retained in position by several catgut sutures. A second flap of deltoid was turned down into the lower cavity and sutured there. The whole surface was treated with "Bipp" technique. Interrupted silkworm-gut and catgut sutures were used for the skin. The arm was bandaged to the side. The patient, who lost a considerable amount of blood (it was impossible to apply a tourniquet), was given 1 pint of coffee and 1 ounce of sugar per rectum.

November 23, 1920. Patient feeling very comfortable. Temperature normal. Color good.

December 10, 1920. Dressed first time since operation—3 weeks.

About ½ dram of moisture on dressing (apparently paraffin and "bipp"). One of the sutures at about the middle of the wound had cut in a little. The sutures were removed. One small granulating area was present at bottom of wound—rest healed. "Bipp." For daily dressing.

December 14, 1920. Healed. To be allowed home for holidays and to return (if all is well) on January 5, for 10 days' radiant heat treatment.

January 5, 1921. Returned soundly healed. For radiant heat.

January 14, 1921. Finished radiant heat treatment. Wound has *not* broken down. Being discharged tomorrow.

Summary. Lieut. H., age 24, wounded April 9, 1917. Fractured humerus. Eight previous operations.

Last operation November 9, 1920. Professor Morison. A cavity in the upper end of the humerus was filled with muscle graft from the deltoid. Healed December 14, 1920—25 days.

CASE 15. Officer A., age 26. Gunshot wound left thigh. Wounded August 13, 1918, by a machine-gun bullet, when flying. The wound healed several times, but broke down again each time, never remaining healed for longer than 3 weeks at a stretch. He has had 10 operations.

November 23, 1920. Admitted to War Pensions Hospital, with very small sinus at center of external surface of left thigh.

November 26, 1920. Operation. A curved incision 8 inches long, excising sinus, was made. The fibrous tissue was excised, the bone exposed, and the periosteum peeled off. A small sequestrum found lying in cavity on posterior surface of bone was removed. The whole area treated with "bipp" technique. The cavity was filled with small fat grafts. The deeper tissues were sutured with interrupted figure-of-eight catgut sutures—also controlling some hæmorrhage from fibrous scar tissue. The incision wound was sutured without tension with interrupted silkworm-gut sutures.

December 18, 1920. First dressing—3 weeks after operation.

The dressing was perfectly dry except for one spot of granulation tissue, about the size of a split pea. This area was in the center of the wound. The whole of the rest of the operation incision was healed by first intention.

December 20, 1920. Healed.

January 20, 1921. Has had radiant heat treatment for 3 weeks and remains soundly healed.

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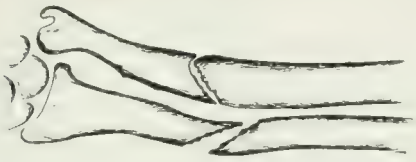

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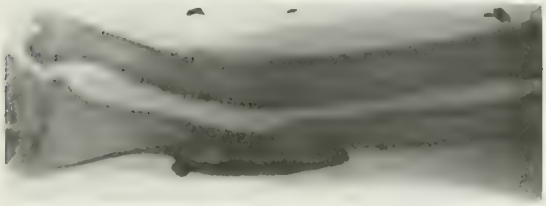

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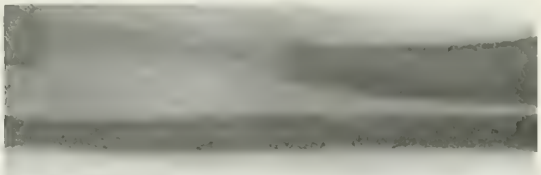

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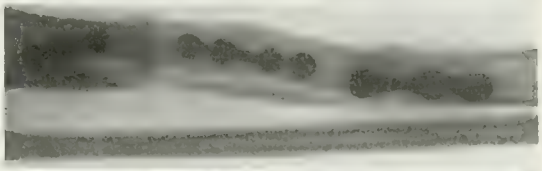

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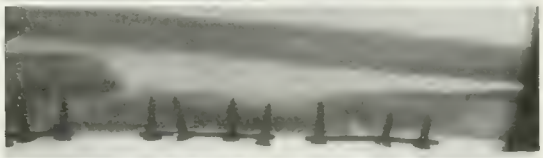

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Fig. 37. Drawing showing condition in Case 25 before bone-grafting operation.

Fig. 38. Roentgenogram, Case 25, 16 months after plating operation.

Fig. 39. Case 26, 79 days after operation.

Fig. 40. Roentgenogram, Case 27, showing condition before Professor Morison's operation.

Fig. 41. Roentgenogram, Case 27, 139 days after operation.

Fig. 42. Roentgenogram, Case 27, 139 days after operation.

Fig. 43. Roentgenogram, Case 27, 6 months after operation.

Summary. Capt. A., age 26, wounded August 13, 1918. Fractured femur. Ten operations have been done since and have failed to secure healing of sinus in thigh.

November 26, 1920. Operation for bone cavity. Fat grafts. Professor Morison.

December 20, 1920. Wound entirely healed—24 days.

Case 16. Pens. M., age 28. Gunshot wound right knee. Wounded July 1, 1916, on the Somme. Three operations before admission.

February 27, 1920. A depressed scar is adherent to the bone over the external condyle of the femur. The knee is ankylosed at an angle of 150°.

April 4, 1920. Fourth operation. A cuneiform wedge was taken out of the lower end of the femur and the upper end of the tibia. Infection followed the operation.

November 8, 1920. Admitted to Ward 3. Three discharging sinuses were present in the incision line on the inner side of the joint.

November 12, 1920. Fifth operation. The old wound had been opened up over the sinuses and two small sequestra were removed.

February 1, 1920. Still discharging sinuses were present —never healed since last operation.

February 3, 1921. Sixth operation. Professor Morison. A cruciate incision and the site of ankylosis explored. Four small cavities were exposed—gouged out and cleaned, "bipp" technique. Several small sequestra were removed. The cavity was filled with pedicled flaps of fat from the under surface of the skin flaps. Spirit. "Bipp." Wounds closed.

February 10, 1921. Discharge had been through dressing 3 times and dressings very wet, so taken down. Still oozing a little at lower end of wound. The rest of the wound was apparently dry and covered with "bipp." "Re-bipped."

February 14, 1921. No more discharge through dressing.

February 27, 1921. Soundly healed. Sutures removed.

March 7, 1921. To wear a plaster bandage on knee.

Summary. Wounded July 1, 1916, in knee (right). Five operations previous to fat grafting. Last operation February 3, 1921 (Professor Morison). Healed February 27, 1921—24 days.

Case 17. Pens. B., age 28. Gunshot wound of right femur. Wounded by an explosive bullet in the right thigh on September 26, 1915. The femur was fractured. He was treated on a Thomas splint for 6 months. Since that date he had never been absolutely healed, there had always been a discharge from a sinus. There had been numerous acute "flares" and abscesses had been incised in different places. Many pieces of bone had come out through the sinuses. Fifteen previous operations.

On admission to this hospital on January 14, 1921, there was a discharging sinus on the outer side of the right thigh, at the junction of the middle and upper thirds. It led down to a cavity in the bone. There was considerable discharge.

February 9, 1921. Operation. Mr. Irwin. The old scar and sinus were excised. The cavity was opened up, and the sides gouged out. The cavity was scraped and

Fig. 44 (at left). Diagram of fixation of shoulder operation with bone graft of humerus. Case 28.

Fig. 45. Diagram of fixation of shoulder operation with bone graft of humerus. Case 28.

cleaned out with spirit and "bipp." The knee joint being stiff, a pedicled muscle flap was cut from the vastus externus and turned into the bone cavity. The skin and muscle were approximated with catgut.

March 2, 1921. Dressed first time. Quite dry and healed by first intention.

Case 18. Pens. H., age 28. Gunshot wound right arm. Compound fracture. Wounded December 20, 1915, by a sniper's bullet—range about 300 yards. Has had 16 operations. Arm has never healed.

On admission, March 15, 1921. Healed scars over upper part of right humerus. Small discharging sinus beneath. Multiple drainage scars on front and back of arm. Operation scar on posterior aspect of arm, partially healed. Two discharging sinuses at upper part of arm.

X-ray shows evidence of fracture of humerus; much callus formation with opening into bone and evidence of necrotic fragment present.

April 1, 1921. Operation. Professor Morison. Anterior scar and sinuses excised by long elliptical incision. Upper end of humerus exposed by separation of deltoid from pectoralis major. A large cavity, 3 inches long, in bone opened up by chiseling through anterior bony wall. The posterior sinus opened into it. A sequestrum, 1¼ inches long, was removed. The cavity and posterior sinus were "bipped," and filled with fat. The wound was entirely closed by fishing gut mattress sutures in center and catgut for edges of wound throughout. Dressed with arm bandaged to chest.

April 4, 1921. Discharge had been through dressings twice, so taken down; looking excellent—a little discharge from back wound—no pus.

April 16, 1921. Quite dry and entirely healed.

Summary. Pens. H., age 28. Wounded December 20, 1915. Fractured humerus. Sixteen operations on arm—never healed. Last operation April 1, 1921. Professor Morison. Healed April 18, 1921—17 days.

Case 19. Pens. J. T. S., age 35. Gunshot wound left thigh. Wounded by shrapnel in the left thigh on September 25, 1916. Has had 12 operations. He was once healed for 6 months after an operation a year ago. Wound has now been broken down for 3 weeks.

On admission March 30, 1921. Large scar 5 inches long, is present on outer side of thigh opposite external intermuscular septum, with 2 sinuses, each about the size of a horse bean, near the center, extending down to bone. X-ray shows cavity in femur.

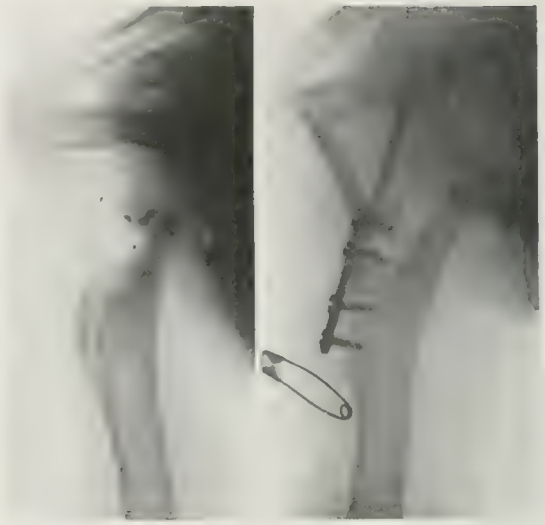


Fig. 46 (at left). Roentgenogram, Case 28, before operation.

Fig. 47. Roentgenogram, Case 28, 94 days after operation.

April 4, 1921. Operation. Professor Morison. The sinus was probed. The instrument passed through a narrow opening on the outer side of the bone into a cavity the size of a bantam's egg. The walls were dense and sclerosed and lined by a thick layer of fibrosed granulation tissue. The cavity was opened up by chiseling away the wall on the outer side. No sequestra were found. There was a lot of scar tissue, fibrous in consistency, lining the cavity. This was scraped and gouged away and when the entire area was exposed spirit was run in, followed by "bipp." Six pieces of fat were then taken from the subcutaneous tissue of the other thigh and packed into the cavity. The muscles were approximated with catgut sutures, the skin with silkworm gut. A small amount of "bipp" was rubbed over incision; dry dressings; boric powder.

April 18, 1921. Dressed first time. Quite dry. The stay sutures were removed. There was a little hæmorrhage from the top suture hole when removed. Otherwise all healed.

Bacteriological report on hæmorrhagic discharge: A few colonies of staphylococci.

May 2, 1921. Still a very little discharge.

May 13, 1921. Healed.

Summary. Pens. J. T. S., age 35. Wounded September 25, 1916. Fractured femur. Twelve previous operations. April 4, 1921. Last operation for bone cavity (Professor Morison). May 13, healed—39 days.

Case 20. Pens. L., age 23. Wounded by machine-gun bullet in the left thigh on October 26, 1917. The bone was broken. He was treated on a Thomas splint for 4 or 5 months, and during that period he was operated upon 3 times. The wound then healed and he was put up in plaster of Paris for 4 months. The wound was open when this was removed. He has had 16 operations, last one 12 months ago. Wound has never remained healed more than a day or two.

On admission, April 4, 1921. There is now a discharging sinus at the bottom of a depressed cicatrix on the outer side of the left thigh, the sinus passing down to the femur in which there is a cavity.

April 8, 1921. Operation. Professor Morison. The sinus was probed. The probe passed down to the outer side of

Fig. 48. Photograph of patient before operation. Case 29.

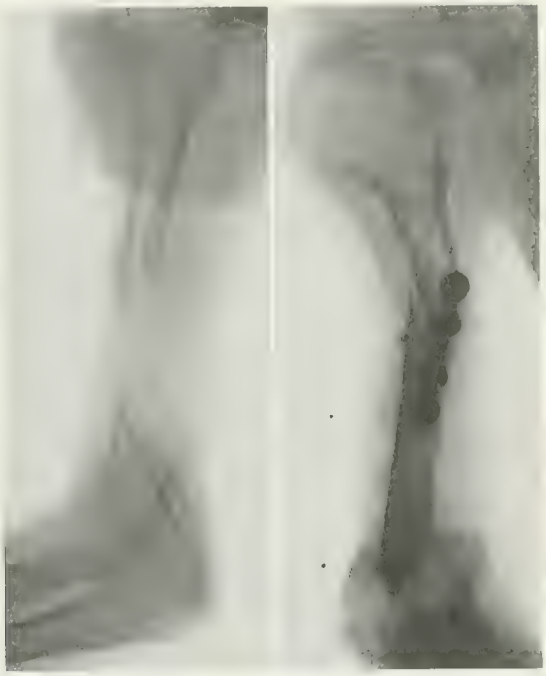


Fig. 49 (at left). Roentgenogram, Case 29, before operation.

Fig. 50. Roentgenogram of arm, Case 29, 85 days after operation.

the femur, which was felt to be bare. A 6-inch incision was made down to bone. Four large sequestra were felt and removed from a cavity deep on the inner and posterior part of the bone lined with soft septic granulations. These were taken away and the area cleaned, "bipp" technique. A separate incision was then made on the outer side of the same thigh and fat taken out. Six small pieces were introduced into the prepared area. The muscles were drawn across with catgut and the skin edges approximated with silkworm-gut, entirely closing the wound.

April 18, 1921. Dressed first time—10 days. Quite dry and apparently healed.

April 24, 1921. Sutures removed. A little serous discharge from center of wound.

April 28, 1921. Not quite healed in center of wound.

May 2, 1921. Quite dry and healed.

Summary. Pens. L., age 23. Wounded October 26, 1917. Fractured femur. Sixteen previous operations. April 8, 1921. Last operation for bone cavity. Professor Morison, April 18, 1921. Healed—10 days. Some serum escaped since sutures were removed. May 2, 1921. Soundly healed—24 days.

Case 21. Pens. D., age 25. Gunshot wound of right thigh. Wounded September 18, 1916. Fractured femur. Persistent sinus following gunshot wound on front of thigh. The wound has healed periodically—never for more than 5 weeks at a time, and when healed the leg was always painful and swollen. Seven previous operations. One and one-half inches shortening of leg.

X-ray shows shadow—? sequestrum,—and cavity in much thickened femur.

April 29, 1921. Operation. Professor Morison. Bone cavity opened up from front. A sinus was found to pass down through the cavity of the femur to the posterior aspect of that bone. A second incision was made at right angles to the lower end of first. The vastus externus was divided and the femur fully exposed. A sequestrum was felt near the back of the bone. After considerable trouble it was removed, by manipulation through the back and front, from the anterior sinus. The sclerosed bone was chiseled out of cavity as much as possible. Eight fat grafts were transplanted from the opposite thigh into the cavity, after "bipp" technique. The vastus externus was sutured with mattress sutures of catgut. The skin was sutured with silkworm-gut. "Bipp" dressing. No plaster.

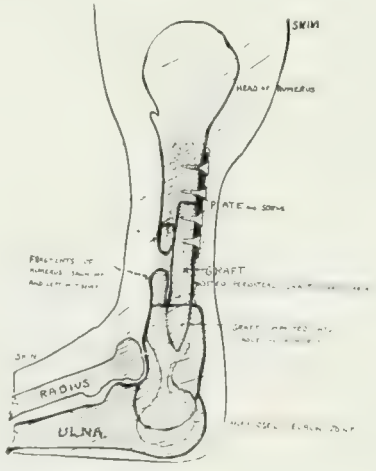


Fig. 51. Diagram of bone graft of humerus, Case 29.

Fig. 52. Roentgenogram, Case 30, before operation, May 15, 1920. Showing irregular upper fragment; lower fragment squared off.

Fig. 53. Roentgenogram, Case 30, January 4, 1921, before Professor Morison's operation.

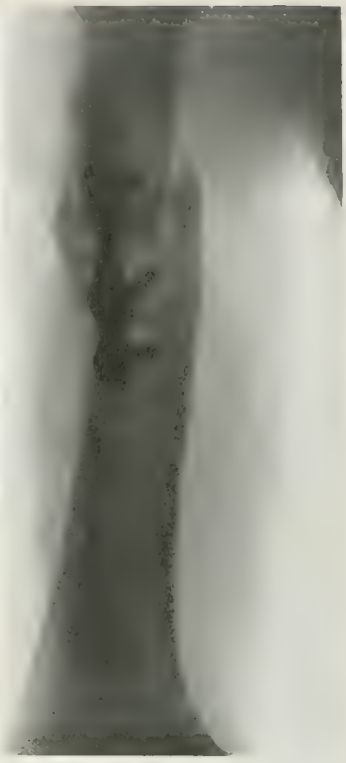


Fig. 55. Roentgenogram, Case 30, 79 days after operation. April 24, 1921.

May 2, 1921. Dressed for first time on account of hæmorrhage through the dressings twice during night, and because patient had a temperature of 101.4° last night. Dressing all stuck tight by hæmorrhagic effusion. Wound looked perfect—free from any signs of inflammation. All stitches were in healthy condition.

June 13, 1921. Still a small (pea-sized) area unhealed at lower end of scar. Small loose piece of bone felt in this sinus 3 days ago?—could not be removed with forceps.

June 20, 1921. Back wound healed. Front wound as before—no bone felt.

July 18, 1921. Almost healed. No bone felt.

Summary. Pens. D., age 25, wounded September 18, 1916, in right thigh. Fractured femur. Persistent sinus—wound healed periodically, but never remained healed for more than 5 weeks at a time. Seven previous operations. Last operation April 29, 1921, Professor Morison. Sequestrum removed, cavity treated "bipp" technique and filled with fat grafts. Dressed first time May 2, 1921. The wound looked perfect and was free from any inflammation.

June 10, 1921. Small piece of loose bone felt in sinus—could not be removed.

July 18, 1921. Very small sinus. No bone felt.

Case 22. Pens. H. Gunshot wound of left leg. Wounded by shrapnel bullet in left leg on April 23, 1917. The tibia was fractured. The longest period that the wound has been healed since discharge was 3 months. He has had 11 operations, efforts to heal the wound.

May 12, 1921. Operation. Mr. Irwin. A longitudinal incision was made over the sinus. The cavity was exposed. No sequestra were found. Granulations were scraped out. The sclerosed bone was chipped away. A fat and muscle graft was swung from outer side of gastrocnemius. "Bipped." The wound closed with "bipped" silk.

May 21, 1921. Dressed. No pus discharge—small granulating surface about center of scar.

June 9, 1921. The wound was entirely healed and firm (4 weeks after operation). No sloughing of skin flaps. No exposure of muscle and fat flaps.

July 8, 1921. Having radiant heat treatment.

Summary. Pens. H. Gunshot wound of left leg. Wounded April 23, 1917. Fractured tibia. Never healed for more than 3 months. Eleven previous operations. Last operation May 12, 1921, Mr. Irwin. Cavity cleaned with "bipp" technique. Fat and muscle grafts.

May 21, 1921. Dressed. One small granulating surface center of scar. June 9, 1921. Wound entirely dry and healed (4 weeks after operation).

Case 23. Pens. C., age 26, wounded November 17, 1917. Fractured humerus. Six previous operations. Never healed.

On admission, July 4, 1921, a large scar was present over the anterior portion of the upper third of the upper arm, with a sinus in the center discharging pus; also scar on back of arm, same level.

July 8, 1921. Operation. Professor Morison. The greater part of the scar and sinus were excised by an

elliptical incision. The periosteum was peeled off and the bone sinus exposed, probed, and found to extend up and down the bone for a considerable distance. The cavity was exposed by chiseling the superficial bone away. The anterior wall of the cavity was chipped away for about 4 inches. It consisted of very sclerosed bone. Five large sequestra and 2 smaller ones removed. The sequestra were lying in the posterior wall of the cavity, and the upper one posteriorly reached the scar at the back of the upper arm. The sequestra were so long that eventually a cavity of about 5 inches in length was left in the humerus, without any anterior wall. The upper and deeper end of the cavity was filled with six fat grafts taken from the fat overlying the deltoid. The remainder of the cavity was filled with a long strip, detached from below up, of the anterior portion of the deltoid muscle. The tongue of the deltoid was sutured with catgut into the lower end of the cavity, and the remainder of the deltoid flap was buried in the cavity by a figure-of-eight catgut suture over it. The incision was completely closed with fishing gut. The skin over the deltoid, outer flap, and remainder of scar were scored. "Bipp." Dry gauze. Boric powder. Arm put up against chest.

July 14, 1921. Dressed first time—6 days. One small granulating area, size of a little finger nail, at lower end of incision wound. Rest of wound healed.

July 27, 1921. Soundly healed.

Summary. Pens. C., age 26, wounded November 17, 1917. Fractured humerus. Six previous operations. Never healed. Last operation July 8, 1921. Professor Morison. Cavity cleaned after "bipp" technique and filled with fat grafts and a long strip of the deltoid. July 14, 1921. Dressed first time. All healed except one small area the size of little finger nail, at bottom of incision wound. July 27, 1921. Soundly healed.

As the cases show it is possible to obtain healing of these septic cavities by "first intention" and, though some of them may take a long time, failure, as I have proved, is an infrequent event. In my experience the greatest obstacle to prompt recovery is the difficulty of securing a healthy skin covering for these fat-filled cavities. Skin flaps are apt to slough, and skin edges united immediately over the packing are apt to separate and expose the underlying fat. In spite of this exposure the fat if protected is not extruded, but after a long time becomes vascularized, the granulations which develop on it join those of the wound edges, and healing occurs with a very small linear depression—not at all resembling an ordinary bone cicatrix. I have watched with great interest this happening in many cases which I have had the opportunity of observing for weeks, until healing had at last followed. Scoring flaps is sometimes sufficient to prevent death of them, from arrest of circulation by œdema, and this should always be done. In doubtful cases, such as those with multiple cavities, or those in which it is difficult to see to the bottom, operation in two stages is an advance on our earlier methods, and we have recently adopted it when skin flaps are necessary to cover the cavities, especially in such

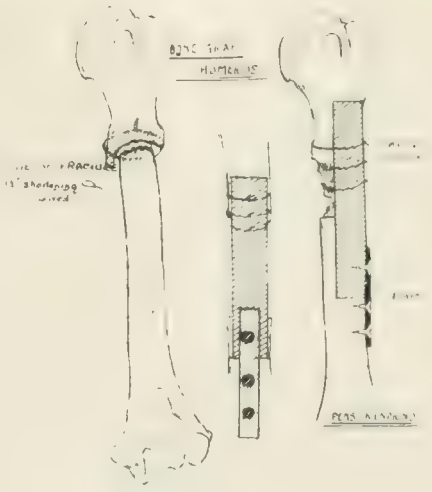


Fig. 54. Diagram of operation in Case 30.

positions as in the head of the tibia, which are specially difficult. In these instances, after preparing the cavity, we outline the skin flap by a deep incision all round, except at the side to be left as a future pedicle. By this means, we hope that in 3 weeks the circulation through the pedicle, increased by cutting off the blood supply from other directions, will suffice to nourish the flap, but our experience with this method is still insufficient to allow of confident statements.

In civilian practice this method of treating bone cavities is applicable to the slowly healing results of bone infection and necrosis. I have also used it in the case of a girl from whose lower jaw I had scooped out a myeloid tumor the size of a large orange (Figs. 33 and 34). The big wound healed after 12 months but left a large deforming depressed cicatrix adherent to the cupshaped cavity previously occupied by the tumor. After dissecting away the cicatrix and removing some of the superfluous bone I filled the cavity with fat grafts, and by undermining the surrounding skin, left them covered with flaps which united by first intention in a fortnight, leaving a linear cicatrix without any depression. The soft fat underlying the scar, easily palpated, became gradually harder until now, a year after the operation, the old cavity is filled with bone, though it is not yet entirely dense to X-rays.

The only addition I have made to the methods described in the "bipp" book is that now the skin around the wound is dusted with sterile boracic powder before the wound is dressed. It is also not always wise to aim at the surgical triumph of a wound healed under a single dressing

left untouched for 3 weeks. Blood escaping into the dressing makes it moist, and especially when old scars are present these are apt to break down and produce raw septic areas, which interfere with primary healing. A second dressing performed at once with gauze wrung out of spirit may save the situation, and it is preferable to the "pickling" which we found so serviceable in the earlier and more strenuous days during the War. If the wound is at all moist, dressings should be changed daily until it is dry.

Bone Grafting

The first patient I am exhibiting shows the result of a failure in technique. Five weeks after the operation when his arm was dressed, because of discharge through the dressings, it was found that the wound had broken down at the upper end and the arm and the leg from which the graft was taken were both suppurating.

What is the explanation?

This patient was the first upon whom I had operated in an entirely new environment—new assistants, new nurses, and new surroundings over which I could exercise little control. While the graft was being removed from the tibia I noticed with sudden surprise that the flow of saline used to cool the Albee saw was splashing from it into my chief assistant's face, and was running in a stream off his nose on to the tibia from which the graft was being taken. This was, of course stopped at once, and the operation was not proceeded with until the sawn tibia had been drenched with saline. There cannot be any doubt that infection of the graft was caused by this mishap, for both arm and leg suppurated. This experience is a gross one but it teaches the need for a trained team, accustomed to work together, for this purpose.

It seems as if the technique necessary to ensure good results must be better in this class of surgery than in any other, because the operation, however carefully done, must cause serious trauma, considerable damage to the surrounding tissues is inevitable, and tissue resistance is still our most powerful antiseptic. It is also certain that if plates, of which I am going to say something later, are used, the danger of infection is increased.

In all the literature referring to bone grafting after war wounds, the danger of infection—latent infection—is emphasized. It is advised that months should elapse after the wound is healed before any such operation is undertaken. Early in the War A. E. Morison, of Sunderland, informed me that he had found radiant heat the best test for healed wounds of the extremities, and I gave orders that patients should be treated by this means at the Northumberland War Hospital. Ten per cent broke down under the influence of radiant heat. Since then all our cases are subjected to a preliminary 10 days of treatment of their scars by radiant heat. If the result of this is negative, and if after operation any infection should develop, we blame, not the patient, but his surgeon.

In bone grafting I still perform all manipulations with instruments only, as an additional safeguard against infection of the wound, though no wound with our present methods is absolutely safe. Perfection in wound technique has not yet been attained. Any doubt as to the truth of this statement has been settled by Dr. Laws, who has had cultures made from our operating theaters during operations. These prove that organisms are constantly dropping into our wounds from the air, and though, judging by results, very few of them manage to do harm it cannot be that they are *all* non-pathogenic as so many surgeons teach.

There are still many problems awaiting solution in connection with bone grafting, but I have only time now to consider one of them.

Fixation of the graft by metal plates has been decried by surgeons as a complete failure. I am going to ask you to keep an open mind still, in the light of my experience, because I have continued, in spite of surgical agreement to the contrary, to use metal plates for special cases. In the humerus and in the femur I do not think any method of fixation can equal the metal plate, if the bone is firm enough to hold screws. If it were true that a plate prevented osteogenesis so that the graft could not unite, plates would, of course, be taboo. But it is not true, and my cases prove it. In the first case exhibited the plates on both ends of the graft were taken off in 5 weeks. The lower end of the humerus was already firmly united to the graft. Ordinarily the ingenious methods of Albee leave little room for competition, and we are all his debtors for the work and excellent outfit he has elaborated, but some of his conclusions need modification. When a plate is used for a superficial bone, or in the neighborhood of old scars, it is best to remove it when it has served its purpose; if the plate is buried under muscle, as it generally can be in the case of the humerus and femur, unless it causes trouble it is best left alone. One of the soldiers admitted to the Northumberland War Hospital under my care had had his femur plated by the late Professor Sinclair White, of Sheffield, 15 years earlier. He had been in the thickest of the fighting for a year, was football expert in civil life, had never had any trouble after

his recovery from the fracture, and X-ray showed the plate to be as firmly fixed as it could have been when it was first put on. I started surgery with a prejudice against plates or any other unabsorbable foreign bodies, but now know that both are sometimes good. There is just one caution as to their use. They are dangerous for surgeons who cannot feel confident that wound infection will not follow their operations.

Experience at the Northumberland War Hospital has taught me that, when bones are shortened by loss of portions of them, if the broken ends are brought together and held there, union seldom occurs. My explanation is that the stimulus of contracting muscle is lacking in these cases and that this inhibits osteogenesis. I do not know whether the explanation is correct or not, but there can be no doubt as to the difficulty of obtaining union. If this view of mine is correct the step graft method is a bad one.

The cases exhibited emphasize these points, and may elicit others for discussion.

Case 24. Pens. C., age 30. Gunshot wound right shoulder. Wounded April 14, 1918, in France. He has had 4 previous operations. The bone has never united.

On admission we found entry wound at junction of upper and middle thirds, on anterior aspect of right humerus. Exit posteriorly. No nerve lesion. Humerus shattered, fully 3 inches being blown away.

November 17, 1919. Operation. Professor Morison. Tibial bone graft and plating. One plate attaching graft to humerus above, and another to humerus below. The upper fragment of the humerus was so soft that the plate was tied on to it with thick catgut, no screws being possible.

December 28, 1919. Dressed first time—5 weeks. The wound had opened up and was infected, and the upper half of the bone graft was uncovered. Firm union had taken place in the lower end of the graft; the upper end was free and projecting through the wound with plate attached. Both plates were removed.

November 30, 1920. There is an extensive open wound over the anterior aspect of the upper end of the right humerus. A bit of bone, 2½ inches long by 1 inch wide is seen. Granulation is taking place in new tissue which is healthy. The condition, though unhealed, is satisfactory, and it is expected that the exposed bone will shortly sequestrate. Thick new bone firmly attached above and below. Head of humerus rotates freely with new shaft.

Summary. Pens. C., age 30, wounded April 14, 1918. Four previous operations. Gap in humerus. Operation—bone graft—November 17, 1919. Professor Morison. Dressed December 28, 1919. Wound opened up. Graft exposed. Union lower end of graft. Upper end free. November 30, 1920. Graft still exposed, but union firm. Humerus reproduced.

Case 25. Pens. P., age 24. Gunshot wound left forearm. Both bones fractured. Wounded October 27, 1918.

January 1919. On the ulnar border of the left forearm, about center, there is a scar 2 inches by 1 inch; on flexor surface, a scar, 3 inches by 1 inch; on extensor surface, about center, a scar with sinus. No nerve injury. X-ray shows fracture of both bones; no union visible; two foreign bodies near anterior skin on inner side; one sequestrum on external aspect of fracture of radius.

February 8, 1919. Operation. Professor Morison Northumberland War Hospital. The three sinuses present were opened up. Two sequestra from radius and one from ulna were removed. The upper fragments of the radius and ulna (ununited) were chiseled and the chiseled portion turned into the gap. The lower fragments were freshened. The whole surfaces were "bipped" and the wound over extensor surface, which had been opened up more extensively than the others, sutured. The arm was put up in full supination and Gooch and metal splinting.

March 8, 1919. Dressed first time. One month. Dressing dry. Radius not united. Ulna firm. The radial wound was healed. The extensor wound was almost healed. The sutures were removed. "Re-bipped." Splints were reapplied.

April 6, 1919. Dressed. Healed. No union in radius. Put up in plaster of Paris. X-ray showed lateral position good. There is a slight angle pointing forward, but no bones are in contact.

September 1, 1919. Operation. Bone graft to radius. There were two healed scars over front and outer side of forearm. An incision was made over the front of the radius between the pre-existing scars, avoiding both. The radius was approached by deepening the incision between the flexor carpi radialis muscle and the supinator longus. As the fractured ends of the radius were exposed they were found ununited, with an imperfect attempt at fibrous union. A flap of bone and periosteum was turned down from the upper fragment. A flap of bone and periosteum was turned up from the lower fragment, forming a bed to receive the graft. An incision was made over the inner surface of the tibia and a graft of bone and periosteum was cut to size from the front of the tibia. Before the graft was removed from its bed, a plate, longer than the graft, was fixed to it with 2 screws, the protruding ends of the plate being secured to the upper and lower ends of the radius respectively after the graft was transplanted to the forearm. Difficulty was experienced in getting a firm screw hold into the lower fragment of the radius, owing to the friable and soft condition of the bone. The upper fragment was also soft and friable, but to a less extent. The muscles were drawn over the radius and the graft by three bootlace sutures of catgut. The skin was united with fishing gut and catgut. The wound on the tibia was sutured. The arm was put up at right angle flexion of elbow. The forearm was fully supinated between the Gooch splinting. A rectangular aluminium splint was applied. Plaster.

October 5, 1919. Apyrexical course since operation. General condition satisfactory.

October 31, 1919. Lower screw has sprung—graft still in position. X-ray shows some bone formation. Discharged with good union of bone and perfectly sound and useful arm and hand, with which he worked regularly at a pit lamp cabin. On January 24, 1921, the patient returned to have the metal plate removed as the lower end sprang out when he was working and was projecting under the skin, causing him inconvenience.

January 28, 1921. Operation (removal of plate) 1 year and 4 months after grafting operation. The tissues were found to be so firmly incorporated with the plate that they had to be cut off it. No sign of irritation. The lowest screw was partially (not totally) loose; the two next had a quite firm hold; the top ones also very firm. (They had become more firmly fixed after operation.) Skin sutured with interrupted sutures of catgut. No splints.

February 14, 1921. Dressed first time. 17 days. Healed by first intention. Quite dry. Sutures absorbed.

Summary. Pens. P., age 24, wounded October 27, 1918. Non-union of radius. Last operation September 1, 1919. Professor Morison. Bone graft to radius fixed with long

Lane plate. October 31, 1919. Lower screw sprung. Discharged with good union of bone and useful hand. Worked regularly until January 24, 1921, then returned to have plate removed as the lower end was projecting and causing inconvenience. January 28, 1921. Removal of plate 15 months after grafting operation. February 14, 1921. First dressing—17 days. Healed by first intention.

Case 26. Age 38. Gunshot wound left forearm, fractured radius. Wounded September 28, 1918, at Hooge.

Admitted, October 25, 1920. Healed scar over the posterior surface of the middle of the left ulna. The hand was held in the prone position. Much radial deflection. The movements of the fingers and the thumb were sluggish. Passive movements were good. X-ray showed gap in Radius.

October 27, 1920. Radiant heat to arm—6 applications.

November 5, 1920. Operation. Professor Morison. Long incision (about 7 inches) on anterior surface of left forearm directly over the anterior edge of the supinator longus muscle. This muscle edge was identified and retracted laterally and on the medial side the flexor sublimis digitorum was medially deflected. The periosteum was incised vertically at the site of fracture, then peeled off. The lower fragment was found to terminate in two horns of bone, one anterior and the other posterior. Both these horns were sawn off, the anterior one being removed entirely, and part of the posterior one being left in the wound. The irregular end of the upper fragment was sawn off transversely. The arm was then forcibly manipulated to undo as far as possible radial deflection. Next a graft of bone 2 inches by 1 inch was cut with the Albee saw from the subcutaneous area of the left tibia. Two plates were applied *in situ*, the plates being each 3 holed. One screw of each plate was applied to upper and lower ends of graft. Graft removed and fitted into interval in radius. The remaining screws on each plate were fixed to the upper and lower fragments of the radius respectively. The muscles were sutured with three figure eight sutures of catgut; the deep fascia with interrupted catgut; and the skin with interrupted silkworm and fine catgut. The thigh was sutured with silkworm-gut. A special right angle Treves aluminium splint had been specially made for this case and this was used together with anterior and posterior gooching splints for forearm, to maintain it in supination.

November 11, 1920. Arm was put up in plaster-of-Paris bands, patient allowed up. (Dressing not touched.)

December 6, 1920. Patient complained that the splint had slipped and was uncomfortable, so dressed—31 days after operation. The wound was quite dry. On the lower end of the tension incision was a granulating area, the size of a split pea. Abundant callus could be felt and the bone appeared firm. The sutures were removed. Spirit dressing. Flannel bandage and plaster-of-Paris. Thigh healed.

January 14, 1920. Plaster removed. Wound healed. Large amount of callus. No callus or union shown on X-ray but bone felt quite firm. Patient very anxious to start work.

Summary. Pens. P., age 38, wounded September 28, 1918. Fracture of radius. X-ray showed gap in radius. No union. Operation, Professor Morison, November 5, 1920, bone graft—2 plates. Dressed December 6, 1920—31 days. Wound dry. One small granulating area unhealed. Abundant callus. Bone appeared firm. In 2 months patient started working in shipyard. New bone quite strong.

Case 27. Pens. S., age 26. Gunshot wound left leg. Fractured tibia. Hit by bullet on September 21, 1917, in the left leg, while in France. The tibia was fractured and there was a lot of consequent sepsis. No union of tibia. A bone graft was put in on October, 1919. The wound healed, but no union followed. X-ray showed bone graft in position.

December 10, 1920. Operation. Professor Morison. Non-union exposed through vertical incision. Bone graft left *in situ*—it was adherent to the surrounding tissue and vascular, but there was no union to bone. Bone ends were cut down and platformed to leave a bony upper and lower bed for the new graft. Old graft rawed with chisel—The graft was cut from opposite tibia. During its removal the graft was fractured in the middle owing to difficulty from sclerosis due to the previous operation. The broken graft was repaired by one plate, and two other plates fixed the graft to the prepared ends of the tibia. The leg was put up in two side Gooch splints, reaching from above the knee to the sole and fixed by three plaster-of-Paris bands.

January 14, 1921. Dressed for first time—5 weeks. Dressing looked quite dry—dry blood clot lying around it. On removing this a drop of pus from the center of the wound could be squeezed out. Sutures removed. Leg felt firm. "Bipped," and put up in Gooch splints with plaster-of-Paris bands.

February 7, 1921. Dressed for second time. Quite dry. A small unhealed spot (pin head). Rest of wound healed. Union felt firm. Put up in plaster-of-Paris, with window cut over unhealed area.

March 11, 1921. Patient has been home for a month and returned today as he *thought* the wound had been discharging into the dressing for 3 days. On taking down the dressings the wound was found to be quite dry and healed, and the bony union firm with abundant callus. Scar smeared with "bipp." Dry dressing.

April 28, 1921. Huge mass of bone is present showing quite firm bony union. No lateral movement is obtainable. The scar has broken down and plates are to be removed.

May 3, 1921. Operation. Professor Morison. Plates removed from tibia—found to be satisfactorily united. Wound sutured with silkworm-gut.

May 13, 1921. Dressed. The wound partially sloughed. No bone is exposed. To be dressed daily.

June 13, 1921. Still a little discharge from granulating areas. Union is firm—big mass of bone present. Patient is walking with a caliper splint.

July 11, 1921. Very little discharge is present.

Summary. Pens. S., age 26, wounded September 21, 1917. No union of tibia. First operation for bone grafting October 1919, by Albee method, which failed as graft did not unite. Last operation December 10, 1920. Professor Morison. Bone graft. 3 plates. January 14, 1921. Dressed first time, 5 weeks. Not quite healed. Leg felt firm. March 11, 1921. Quite healed. Bony union with abundant callus. April 28, 1921. Now strong thick tibia. Plates to be removed. May 3, 1921. Plates removed. May 13, 1921. Dressed. Wound edges partially sloughed. No bone exposed. June 13, 1921. Still some discharge from granulating areas. Union firm. Patient walking on caliper splint.

Case 28. Pens. R.P.W. Age 32. Wounded April 13, 1917, at Arras. "Blown up" by a German bomb. Either 7 or 8 operations had been done before admission. Notes state that the head of the humerus was removed.

On admission July 16, 1920. Absence of head of left humerus. There is a healed scar running downward on the anterior surface of the upper arm from the middle of the acromion process. A large sinus tracks upward. The elbow joint normal. The scapular movements are good, but his arm hangs helplessly by his side.

Treatment. For sequestrectomy of humerus and subsequent fixation of shoulder operation when arm is satisfactorily healed.

July 23, 1920. First operation. The sinus was excised and fully exposed; well scraped out; dressed after "bipp" method. No deep focus of infection was found. The wound was sutured. No drain.

August 10, 1920. Dressed first time—18 days. Upper two-thirds of wound healed by first intention. At lower

third an opening discharged seropurulent fluid. "Re-bipped."

September 13, 1920. Healed. After 10 days of radiant heat, the patient was discharged soundly healed.

January 10, 1921. Patient returned for fixation of shoulder to have radiant heat for 10 days.

January 20, 1921. Finished radiant heat treatment. No breaking down of scar. Patient has been wearing an abduction frame made to fit him for a few days, to ensure its being comfortable after the operation.

January 21, 1921. Operation. Professor Morison. Lateral incision over site of destroyed deltoid down to the remains of the joint and upper fragment of humerus. The head of the latter bone had entirely gone, together with the two tuberosities. The glenoid cavity was exposed, and by means of an Albee drill a hole was bored upward, backward, and inward from its center. The humerus was then exposed for 1½ inches. It was cut transversely through two-thirds of the shaft, 1½ inches from the end, then longitudinally on each side into the medulla, and the separated fragment was turned up and over, still attached by its extremity, to form a bed for the graft. A pointed-end graft was then cut from the subcutaneous surface of the tibia, and the sharp end of the graft was held by strong forceps and hammered into the drilled opening in the glenoid. The distal end of the graft was plated down to the humerus in the plateau already prepared. The acromion process was then split horizontally and the lower half was fractured downward to the graft (as illustration). An osteoperiosteal graft was chiseled up from the tibia and placed in position over the bare outer surface of the graft and sawn acromion. Fibrosed muscles were sutured over with catgut. Skin edges approximated with catgut. The arm was put up in abducted position on a frame and fixed with plaster-of-Paris.

March 7, 1921. Dressed for first time—6 weeks and 3 days. Wound healed with the exception of two areas—one at the lower edge of the wound, the size of a split pea; the other just over the acromion process, size of a pin head. A large mass of callus was palpable all round the glenoid, and there was no trace of movement. The bones appeared to be united. "Bipp." Boric powder. Dry dressing. Put up on frame and plaster-of-Paris as before.

April 15, 1921. Dressed second time—6 weeks since last dressing. There is a small granulating area, the size of a split pea, over the acromion process. Rest of the wound is healed. Large mass of callus is present. Union is quite firm. There is good movement of scapula. The arm is to be taken down from abduction frame every day for massage and dressing.

April 28, 1921. Arm in good position—down to side now. Not quite healed. Plate appears to rock—to be removed.

May 6, 1921. Operation. Plate removed.

June 13, 1921. Healed. Mass of callus union not solid.

June 17, 1921. Arm put up on abduction frame with plaster of Paris.

Summary. Pens. R.P.W., age 32, wounded April 13, 1917. Seven or eight operations before admission. Head of humerus had been removed for ankylosis of humerus to scapula. Last operation January 21, 1921 Professor, Morison. Bone graft. Plate at lower end. March 7, 1921. First dressing—6 weeks and 3 days. All healed except two small granulating areas. Large mass of callus present. Bones appear to be united. April 15, 1921. One small granulating area unhealed. Union at both ends appeared firm. Large mass of callus. Good movement of scapula. May 6, 1921. Operation plate removed. June 13, 1921. Healed. Big mass of callus, union not yet strong. June 17, 1921. Arm put up on abduction frame and plaster-of-Paris.

Case 29. Pens. C.A.N., age 21, wounded on April 28, 1917, at Arras, by a bullet—range 300 yards. Was taken prisoner by the Germans for 10 months and was operated upon during that time. Has had 3 operations before admission. Note from English Hospital.

February, 1919. Compound fracture of humerus, middle third, non-union. Arm, forearm and hand much wasted; 15 degrees of movement at elbow; extension at elbow not beyond 90; wrist stiff at about 180; fingers stiff and contracted by flexor tendons.

February 17, 1919. There are the remains of a median nerve lesion in this case with some sensory loss in index and thumb. Despite the appearance of the arm, every muscle has power and reacts to faradism, except perhaps opponens and abductor pollicis.

May 23, 1919. For bone graft or wiring.

May 30, 1919. Left hand cock up splint. Movements wrist and finger joints under gas.

September 22, 1919. Operation. Long incision was made and the wound scar was included in the ellipse and excised. The musculospiral nerve was identified and retracted. The lower end of the bone was found very much rarified—marrow soft, almost fluid and yellow. The two ends were "stepped" and wired. The musculo-spiral was displaced to a more superficial position and embedded in muscle. Arm fixed in abduction splint. X-ray showed both wires round upper fragment and ends separated without union.

November 24, 1919. Operation. Incision as before. Musculospiral nerve identified and displaced. The ends of the fragment were sawn across until a flat, healthy surface was reached. A plate of boiled beef bone (shin of ox) was drilled with 2 holes at each end, and the ends of the fragments were drilled also. These were threaded with kangaroo tendon and tied securely. The whole length of the graft was wrapped closely to the fragments by chromic catgut. Muscles sutured with catgut, skin with silkworm-gut. The wires were removed at an early stage.

December 2, 1919. A stitch at upper angle has suppurated—small Carrel tube inserted.

January 11, 1920. Transferred to Newcastle.

January 14, 1920. In plaster. Awaiting bone graft. During the year has been having massage to improve condition of hand. Also radiant heat.

January 26, 1921. Wearing a special abduction frame to ensure its being comfortable after operation.

January 28, 1921. Operation. Professor Morison. An incision was made on outer side of the arm excising the old scar, and longer than the previous one. The musculo spiral nerve was identified in the scar and retracted to the outer side of the bone, the ends of which were turned out, without separating the soft parts from the conical ends and exposed. The upper end, narrow in diameter and friable in consistency, was bared of its periosteum above the end and the sclerosed extremity was partially sawn through. The upper half of this fragment was turned down into the space between the bone ends. The lower end was exposed, found irregular, and dealt with in like manner. By means of a gouge the medulla and soft bone from the lower end were scraped out for just over one-half inch.

A pointed graft, sharpened at one end only, was then cut from the left tibia with the Albee saw, and the pointed extremity was driven into the gouged-out medulla of the lower fragment. The upper end of the graft was then brought into apposition with the upper fragment, lying on the turned in fragments from the two ends. In this position it was plated, 2 screws being applied to the friable bone end neither of which had any grip, and 2 to the graft. In order to secure this temporarily a thick catgut ligature was passed underneath the upper fragment and over the plate and screws. A small osteoperiosteal graft was chiseled up from the tibia and applied to the junction of the bone with graft at its upper end. Muscle and scar

tissue were approximated over graft with catgut sutures. The skin was sutured with silkworm-gut. The arm was put up on celluloid abduction splint with plaster-of-Paris jacket and bandages. Leg wound closed with fishing gut.

March 11, 1921. Dressed first time—6 weeks. A little moisture, about ½ dram, on dressing—not purulent. Sutures had all held, and except for a little place in the center, one-quarter inch long, which was granulating, and for a split-pea sized granulation in the upper third, the wound was healed. Union firm. "Bipp." Dry dressing. Boric powder. The arm was put up against the chest with abundant cottonwool and retained in position with plaster-of-Paris bandages. The hand was left free.

April 22, 1921. Dressed second time—6 weeks since last dressing. Quite dry and entirely healed. Union firm. Arm put up in sling—no splints. To start movements of fingers.

Summary. Pens. C.A.M., age 21, wounded April 28, 1917. Fracture of humerus. Three previous operations—wiring and step method and bone grafting of humerus. Last operation January 28, 1921. Professor Morison. Bone graft and plating. Dressed March 11, 1921—6 weeks. All healed except one small granulating area. Union of graft appeared firm. Second dressing April 22, 1921—6 weeks. Entirely healed and union firm.

Case 30. Pens. K., age 27. Gunshot wound left humerus. Wounded September 16, 1916, in France, by shrapnel. Fracture. Has had 5 or 6 operations when attempts were made to wire and plate the humerus.

On admission, May 14, 1920, there was an ununited fracture in upper third. Little loss of bone substance. X-ray: irregular upper fragment—lower squared off.

August 25, 1920. Operation. A long incision was made along the anterior border of the deltoid. A large amount of scar tissue was excised. The bone ends were exposed, squared off, and cleared of scar. Step cuts performed on the two ends. Two holes were drilled and silver wire was passed through, tightened, and the sharp ends buried. The muscle was closed over bone, and the wound sutured. The arm was put up on abduction frame.

The wound healed almost immediately and without removing the wire. The X-ray result appeared excellent, but on taking the arm off the splint, it was found that there was only fibrous union.

February 4, 1921. Operation. Professor Morison. Excision of old scar. Non-union exposed. The wire inserted in the previous operation was extracted. What union existed was purely fibrous and there was no deposit of new bone, despite the accurate apposition of the fragments. The sclerosed bone ends having been cleared and separated were partially sawn through and turned up at the distal end into the gap. The proximal bit was removed, leaving a shelf for the graft to lie on. A tibial graft, a wide one, cut the length of the gap left after forcible stretching of the upper arm, was marked out with the Albee saw and before complete removal from its normal position a three-screwed plate was applied at either end—the single screw on the graft. The graft with plates affixed was then lifted out and placed on the prepared shelf in the humerus. Holes were drilled in the lower fragment of the humerus and screws inserted. The bony tissue of the upper fragment would not grip the screws, and so the upper plate was removed. Catgut (thick and doubled) was passed around the graft and upper fragment and in this way some immobilization was maintained. The bone was so soft that when held with forceps it collapsed. The muscles were approximated and the skin sutured with silkworm-gut and catgut. The arm was put up by the side and enclosed in plaster-of-Paris.

March 18, 1921. Dressed first time (6 weeks). The old scars had broken down in several places and left protuberant granulations. Incision scar was all healed except for pin head granulations opposite six of the sutures. The anterior scar had broken down, forming granulating area, size of sixpence. Union of graft appeared quite firm. "Bipp" and boric powder dressing. Arm put up as before.

April 24, 1921. Dressed second time—5 weeks and 3 days. Firm union. Good movement of shoulder. Granulations as before. Incision wound healed. To be dressed daily.

April 28, 1921. Still a granulating area in center of scar.

June 13, 1921. Two small granulating areas—at the bottom of each of these bare bone could be felt. Large amount of callus, but union not solid.

July 1, 1921. Granulations have been touched up with nitrate of silver. The arm has been put up on abduction frame with plaster-of-Paris.

July 15, 1921. Operation. Plate removed. Firm union.

Summary. Pens. K., age 27, wounded September 16, 1916. Fracture of left humerus. Five or six previous operations. Attempts to step method and wire and plate humerus. Last operation February 4, 1921. Professor Morison. Bone graft and plate. Dressed March 18, 1921 (6 weeks). One or two small granulating areas in scars. Union of the graft appeared to be firm. June 13, 1921. Probe through granulations touched bare bone. Large amount of callus, but union not solid. July 15, 1921. Plate removed. Bone firmly united.

I wish to thank Dr. Arnison and his department for the X-ray photographs; Captain Russell for the drawings and for diagrams from X-ray findings; and Colonel Greig for leave to publish the cases.

CONCLUSIONS

Clinical observation and experience are still of more value than laboratory findings and experiments in connection with the condition of wounds and as a guide to their treatment.

The "bipp" method of treatment of infected wounds has established the fact that, by the use of suitable antiseptics, such wounds can be closed with impunity and that healing "by first intention" may follow.

If it is possible to close infected wounds with impunity, it should also be possible to open abscesses and, after treatment of them with antiseptics, close them again. The cases recorded show that this can be done.

Septic bone cavities have been the most prolonged and troublesome results of the late War. The largest and most obstinate can heal after treatment by the "bipp method" and if filled with fat grafts, by "first intention."

If the wound opens up, or the skin covering it sloughs, exposing the fat grafts, these need not be extruded but will gradually become vascular and eventually will be replaced by new bone. Difficulty in obtaining a satisfactory skin covering is the chief cause of delayed healing.

Failures after fat grafting are the result of faulty technique.

Bone grafts. Lane plate fixation of bone grafts can be successful where other methods have failed.

THE MOURE OPERATION FOR REMOVAL OF LARGE GROWTHS AND FOREIGN BODIES FROM THE ANTRUM[1]

By VIRGINIUS DABNEY, M.D., F.A.C.S., Washington

THOSE of us who had the pleasure and profit of studying in the clinics of Germany and Austria in those halcyon days before the Great War will doubtless recall how aghast we sometimes were at the operative procedures we witnessed there which seemed to take no account of cosmetic results and to ignore the comfort and convenience of the victims. Thus, the operation of lateral rhinotomy, which Moure developed and really devised, would appear to be a mutilating and bloody procedure, whereas, properly performed, it is neither the former nor especially the latter. It is due to the boldness of conception and skill of performance associated with an intimate knowledge of the special anatomy involved, that such operative methods are devised and are successful in their performance.

The especial place for this operation is where the naris is crowded with neoplasms, either benign or malignant, single or multiple, which are evidently overflowing from the antrum, though there are usually in addition independent foci in the ethmoid and even sphenoid; and, moreover, where repeated removal through intranasal methods has proved futile in preventing recurrence. Usually deformity and dislocation of the eye, cheek, and nose, especially the eye, occur before the extensive nature of the disease suggests itself to the attendant or patient. The reason for this is that an accumulation in the open naris does not cause the deformity, as a rule, but that one in the interior of the antrum does. Thus, while the growths are being removed carefully and thoroughly from the open cavity of the nose, those in the antrum continue to grow and their pressure increases, despite the intranasal work, until the cheek, eye, and even the roof of the mouth show the characteristic deformity of great and unrelieved pressure.

The technique which I employ is essentially that of Moure, aside from those minor details which every surgeon is apt to exhibit, such as the control of hæmorrhage, the use of retractors, and the postoperative care. Argyrol is first instilled in the eye of the operative side, the face is then painted with tincture of iodine, which is immediately removed with alcohol, and the eye covered with a pad wrung dry from a bichloride solution. The usual towels are draped over the head and neck to cover all but the part to be attacked. A curved incision is made, parallel with and one-eighth inch below the infra-orbital margin, beginning at and below the outer canthus and extending to a little below the inner canthus. From this point it is carried straight down, along the juncture of the nasal ala and the face to the edge of the nasolabial junction. The bleeding is, of course, brisk and must be controlled as the incision is lengthened, step by step, as the blood will completely obscure the field and prove very embarrassing unless so arrested. Having secured a practically dry field, the periosteum is now elevated, and it must be done with the utmost care and thoroughness, avoiding not only tears but also leaving *in situ* any of its extent. Upon this seemingly unimportant detail depends at least half of the success of the surgeon's attempts to secure a good cosmetic result. In order to prevent bruising of the parts and the possible formation of slough, it is important at this stage to remove all artery clamps where they can be dispensed with and to retract this roughly triangular flap with a loop of silk run through the apex of the tissues; in other words not with metal retractors. Here, again, an effort is made to insure primary union of the soft parts for reasons previously stated. The ala of the nose is now elevated and access gained to the nasal bone and the nasal process of the superior maxilla, and all hæmorrhage controlled. Before proceeding with exposure of the interior of the antrum and naris, the posterior naris is packed and the use begun by the anæsthetist of an aspirator such as is used in tonsil operations. This instrument must be kept continuously in the throat to catch any blood that may escape through or around the nasal packing until all the growths have been removed, the hæmorrhage controlled, and the general cavity packed. The separation of these masses, especially when malignant, is attended generally by profuse flow of blood which, of necessity, would proceed down the rhinopharynx and into the trachea unless preventive measures had been taken well in advance; even so, it is at times necessary to renew the packing because of its becoming saturated with blood. With a square-edged chisel, a section of bone is now marked out, corresponding in extent and contour with

[1] Read before the American Academy of Ophthalmology and Otolaryngology, October 1, 1921.

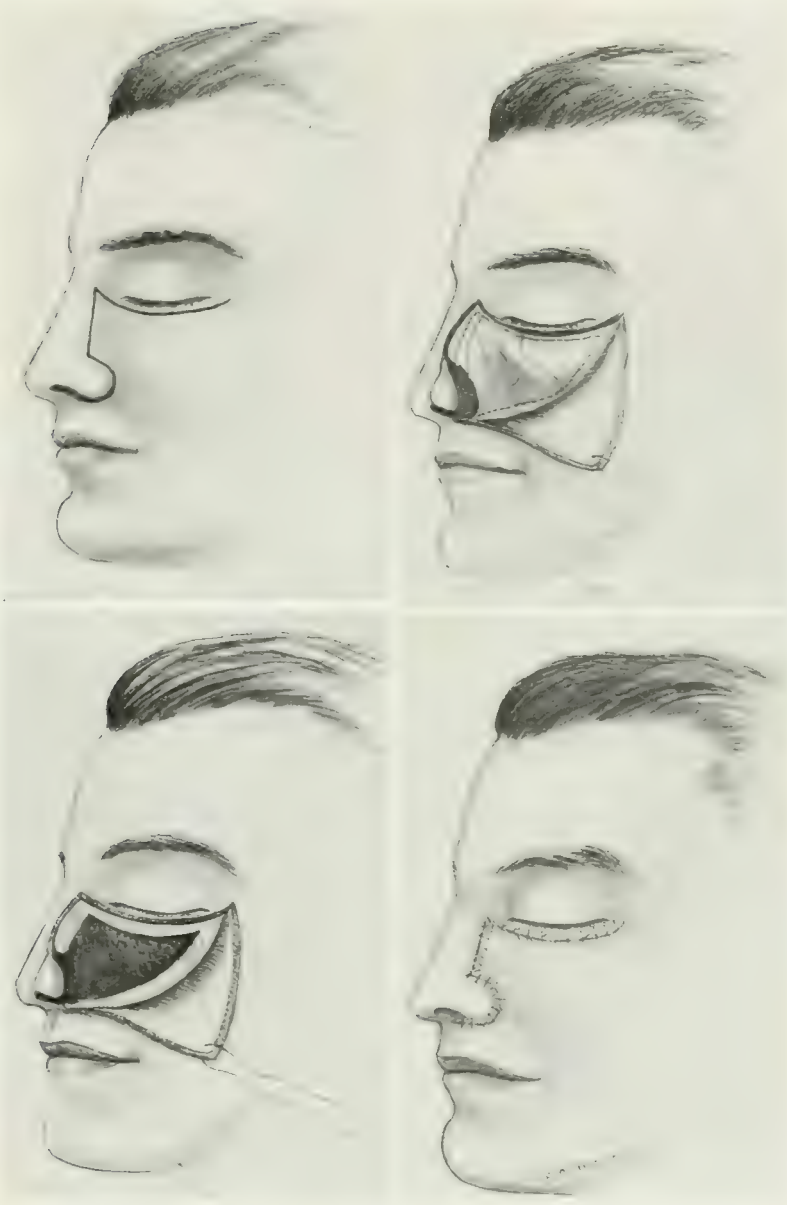
the skin flap, but with this additional area: the posterior half of the nasal bone and so much of the nasal process as may be necessary to allow free inspection of the interior of the nose and the ethmoid. When this area marked out by the chisel has been broken out with suitable forceps, there lies before the eye the entire interior of the antrum and nose, easily accessible to any instrumentation that may be required by the special necessities of the case. No other method will so reveal this general cavity or even if attempted will do so with such safety and thoroughness. It is now an easy matter to remove all growths from their numerous attachments, either in nose or antrum, and I personally prefer the finger where possible, supplemented by curettement of the entire surface and removal of all tags and shreds with any grasping forceps, my preference being the Luc. After packing with gauze impregnated with Dakin oil solution, the wound is sewed up in two layers, care being taken in approximating the skin edges. The end of the packing is pulled down to the edge of the nostril, where it is readily found to be removed on the third day. An ice bag is kept on the cheek continuously for 2 days. In the absence of malignancy, or much foul discharge, a repacking is not usually necessary, though this can be done if the attendant wishes, as the nostril offers all the room necessary for it and for free inspection. Gentle, warm saline irrigation two or three times daily is usually all the after-care that is required in benign cases. However, in the presence of malignancy, the wound cannot be closed, but must be left open and treated as any other open wound, and the use of the X-ray and radium persisted in. With this exception, generally there is no depression or deformity in the face; in fact, where primary union takes place the scar is hardly visible.

The removal of foreign bodies by the route of this operation is essentially the same as described for that of neoplasms, though the interior of the nose may not require exposure, and, in this event, the removal of the bony flap involving the nasal bone and the nasal process may be omitted. However, it will still be necessary to elevate the nasal ala and push it aside to give sufficient room for manipulation of the rest of the flap. Foreign bodies gain entrance into the antrum and nose as the result of industrial accidents, such as the breaking of a flywheel or other revolving and rapidly moving mechanical devices, with the breaking loose of steel masses, striking a patient in the cheek and nose. Also, during the war, instances were numerous where projectiles in whole or in part found their way into the antrum. In this latter type of injury, the skin incision must take into account the wound of entrance and will accordingly depart from the classical incision described here. For instance, there came into my hands a soldier who had received a piece of shell casing just below the malar bone, which had made its way into and through the antrum, emerging through the hard palate. However, in its journey it had split, leaving half of its bulk in the antrum. Here, obviously the thing to do was to follow the wound already made, and the base of the triangle was reversed, being at the infra-orbital margin, and the shape of the incision was more crescentic than triangular, including the nasal incision within its curve. This young man had had for years an empyema of that antrum which was permanently cleared up as an incident of the operation for removal of the fragment of shell casing.

To anyone who has done war surgery and to plastic surgeons whose extraordinary achievements during the war are well known, this operation is almost absurdly easy, but it was not given to all of us to have such experience, and thus the Moure operation as a means of creating and approaching the joint cavity of antrum-nose-ethmoid should be kept in mind and a description is not out of place for the rhinologist.

Rather than giving the arid details of cases I will describe only one, especially as this patient had the rare and somewhat undesirable experience of having both sides operated upon, the second operation involving the frontal sinus as well as those usually affected.

A colored boy, age 19, desired relief for nasal stoppage of the right side, and examination revealed complete blocking of that side with numerous grayish polyps, and perhaps slight bulging of the antral wall anteriorly. Repeated removal of these growths gave no permanent relief, as they reformed rapidly, and the antral wall gradually bulged forward, but this was the only deformity noticeable. A roentgenogram showed marked density and another rhinologist performed the classical Moure operation, at which I happened to assist. The interior was crowded with slippery growths found subsequently to be fibromyxomata, but the skin incision did not hold well and there was slight depression of the scar, the patient remaining in the hospital several weeks. A year and a half later he returned and fell into my hands. At this time the right naris was free of growths, but the left was now full as in the first instance, the cheek bulging, the eye prominent downward and forward, causing the so-called "frog face". He complained not only of difficulty in nasal respiration but also of headache referred to the brow and vertex. The roentgenogram showed, of course, equal density on both sides, but as I was familiar with the history of the case, I at once operated and found a characteristic condition—antrum, ethmoid, and nose



Author's modification of Moure operation to remove large growths and foreign bodies from antrum.

crowded with fibromyxomata. However, as the brow was distinctly soft and bulging and the orbital plate completely destroyed, I made an incision in the hair line which joined the other incision at the canthus, and removed the anterior frontal wall, finding the entire floor of the sinus gone and the upper third of the globe of the eye well within the frontal sinus limits. There was obliteration of the anterior ethmoid; so that there was already ample drainage into the nose. Thus, the frontal sinus, naris, and antrum were thrown into a common cavity, and the frontal and facial wounds healed by first intention, the patient leaving the hospital in a week with no scar visible. Three weeks later, he returned, showing a break in the wound in the center of the cheek, but this healed in a few days and did not mar the cosmetic effect in any way. Eight months after this visit the condition was still good with no return on the left, but on the right, the side first operated upon, there was a return of the growths, though he appeared well and was not in especial discomfort from this accumulation. He has not returned now for a period of 2 years.

This operation appeals to me for its safety, rapidity of convalescence, and absolute certainty of removal of all growths and diseased tissue. Nothing can take the place of the ability on the part of the operator to see what he is doing and what the conditions require him to do. Such desiderata cannot be obtained so well, if at all, by any other method of relieving the condition for which the Moure operation is devised and properly applied.

PRACTICAL METHOD OF FIXATION IN FRACTURES OF THE MANDIBLE[1]

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SURGEONS as a rule show little direct interest in fractures of the lower jaw, and the principles that should govern the fixation of these injuries frequently appear to be imperfectly understood. The usual method adopted is the application of the Barton or other head bandage, in the belief that this provides sufficient fixation. The bandage alone is no more reliable here for retention after reduction of displaced fragments than it would be in a fracture of any other bone. Only cases which would do well without any form of fixation whatever show satisfactory results after treatment with the bandage. In the mandible, more accurate restoration of the parts is essential than in other bones, because the slightest deviation will produce mal-occlusion of the teeth and interfere with mastication. The essential principle to be followed, therefore, is fixation of the fragments in proper relationship with the upper jaw. In order to minimize infection and the prolonged treatment resulting therefrom, this fixation should be applied as soon as possible. It is impossible to maintain the upper and lower teeth firmly in occlusion with a bandage, and if the fragments are properly fixed otherwise, no bandage is necessary, except to hold a dressing in case of external wound. Sometimes, in a case of difficult reduction, the surgeon may be tempted to wire or plate the fragments, forgetting that nearly all mandibular fractures are compound into the mouth and are constantly bathed in the oral secretions. Infection occurs around the wire or the metal plate, inviting osteomyelitis with sequestrum formation and great delay in union. The only justification for wiring or plating of the fragments is one of those rare cases of fracture in an edentulous person where the oral mucous membrane has not been broken and where there is consequently a chance of maintaining asepsis. Even here, the wire or plate usually gives insufficient stability.

After a mandibular fracture has been treated unsatisfactorily for several days, either by bandaging or by an open operation, and infection at the site of fracture has become well established, the patient frequently is referred either to an oral surgeon or to a dentist, usually the latter, with the request that an interdental splint be made. In large cities these patients come to the dental college clinics. It is unquestionably true that some form of interdental splint is one of the best methods of fixation, and in a few cases with great comminution and displacement is the only satisfactory treatment. There are many practical difficulties which interfere with successful employment of the interdental splint. The making of a splint demands considerable experience, at least 2 days of time devoted to nothing else, and involves some expense. Most cases of fracture of the lower jaw occur in persons in poor circumstances who apply for treatment at free dispensaries or dental colleges, where students have to be depended upon for the making of

[1] Presented at the meeting of the Clinical Congress of American College of Surgeons, October 25, 1921.

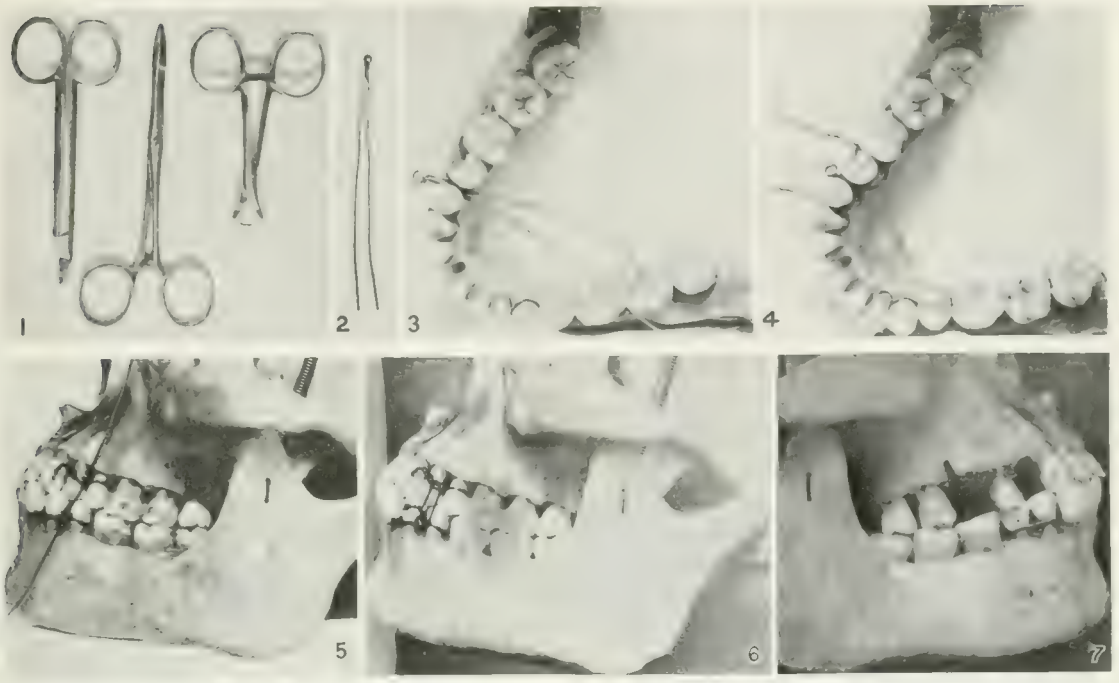

Fig. 1. Instruments required for manipulating wire; towel clamp hæmostatic forceps, aud short-nosed scissors.

Fig. 2. Wire twisted to form eyelet.

Fig. 3. Ends of eyelet wire inserted between premolar teeth.

Fig. 4. Ends of eyelet wire carried around premolar teeth back to buccal surface.

Fig. 5. Eyelet wires attached to upper and lower premolar teeth. Connecting wire passed through eyelets.

Fig. 6. Upper and lower teeth fixed in occlusion by connecting wire passed through eyelets. Ends of wires twisted, cut off, and bent over.

Fig. 7. Eyelet wire attached to single tooth in upper jaw.

splints. Busy dentists, even though experienced in this work, cannot give up all other patients and devote at least 2 days to making a splint. Dental students have other duties, such as attendance at classes to interfere, and moreover are insufficiently experienced to produce accurate splints in the desired length of time. Under these circumstances usually from 2 to 3 weeks elapse between the taking of the impressions and insertion of the splint, which even then may not fit accurately. In the meantime, unless some other means of fixation has been used, the fracture is in process of union in malposition. Therefore, for fixation of the average case of mandibular fracture, we do not now depend on splints, but employ immediate ligation of the lower to the upper teeth, thus reducing and fixing the fracture the first time the patient is seen. This being accomplished, the case may be carried to completion by means of the wiring, or the wires may temporarily suffice until a splint can be made and inserted.

The object of this communication is to bring to more general notice a method of wiring the teeth which, with a little study and practice, should be easily acquired by any surgeon and enable him to handle satisfactorily these cases of fracture of the mandible himself, particularly in localities where specialists are not available. In this way fixation of the bone and care of the soft tissues are under one person, as in other fractures, and there is no division of responsibility.

The method advocated here is a modification of that devised by Colonel Robert T. Oliver,[1] Dental Corps, U. S. Army, developed by Major Joseph D. Eby, of the same corps, and adapted to civil life injuries by the writer. The wire used should be of such a size that it will pass freely through the spaces at the necks of the teeth, and composed of a soft, yet resistant metal. For routine use, two kinds of wire are employed, 22 or 23 gauge copper wire, and the large size (24 to 26 gauge) Angle's brass ligature wire obtainable at any dental supply house. In emergencies, soft silver wire is usually to be found in every hospital, or an efficient substitute in the form of soft iron

[1] J. Am. M. Ass., 1913, liv, 1157-1161.

Fig. 8. Fig. 9. Fig. 10.

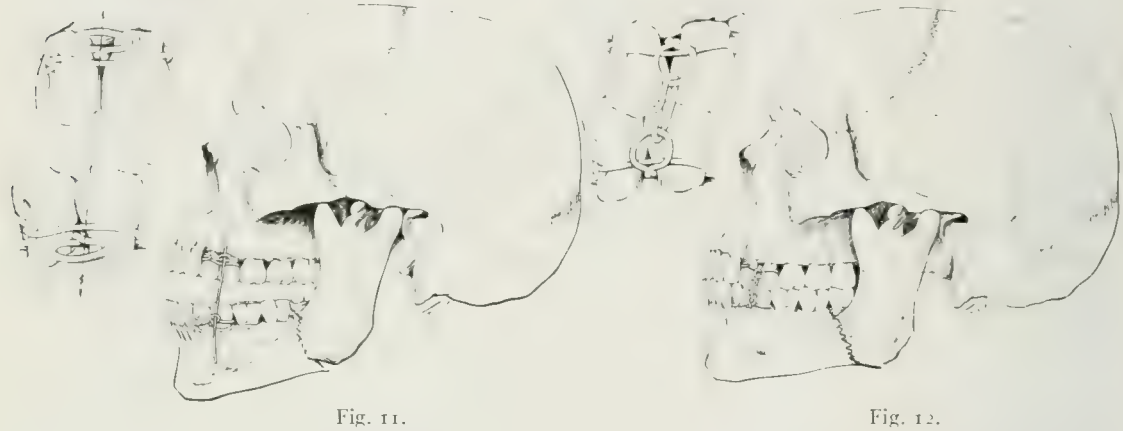

Fig. 11. Fig. 12.

Fig. 8. Fracture with a long posterior edentulous fragment which has been drawn upward by the muscles of mastication.

Fig. 9. Posterior edentulous fragment kept down by piece of impression compound.

Fig. 10. Fracture reduced and anterior fragment fixed by wires.

Fig. 11. Retention of tooth in line of fracture to prevent tipping up of posterior fragment.

Fig. 12. Fracture reduced and fixed by wiring teeth.

binding wire can be purchased at any hardware store. The instruments needed are a pair of hæmostatic forceps, a pair of short nosed scissors, and a tenaculum or a Backhaus towel clamp (Fig. 1). In preparation of the wire to be attached to the teeth, a six inch length is folded around the tenaculum or towel clamp, and a loop is twisted in the form of an eyelet (Fig. 2). Where there is a good dental interspace, the copper wire is used, as it makes a firmer attachment. Where the teeth are set close together, as in the case of the lower incisors, the brass wire is employed. After selecting the teeth to be wired, both ends of the eyelet wire are inserted from the buccal surface through the interproximal space, for example, of the two lower premolars (Fig. 3). One end is drawn through around the anterior tooth and the other end around the posterior tooth on to the buccal aspect (Fig. 4). This process is repeated on corresponding upper teeth. Then the ends of the wire in the case of the lower teeth are twisted together with the eyelet projecting below the twist. In the case of the upper teeth, the eyelet projects above the horizontal twist. In this way the upper and lower eyelets are prevented by the horizontal strands from coming too close to each other when subjected to the strain of the connecting wire to be described. Tightening is done by grasping the ends of the wire with the hæmostatic forceps, drawing the wire away from the teeth and twisting carefully at the same time. The eyelet may be prevented from disappearing in the interproximal space by engaging it with the towel clamp. The ends are then cut off short and bent in so as not to irritate the lips (Fig. 5). The selected teeth on the opposite side of the mouth are then treated in the same manner, and if desirable a third set of teeth is similarly wired in

the incisor region. The upper and lower eyelets are now connected by passage through them of a third, connecting or tie wire, the brass wire being used here (Fig. 5), the teeth brought into occlusion and the ends of each connecting or tie wire twisted together, cut off short and turned in (Fig. 6). In some cases of displacement the desired movement of a fragment to restore proper occlusion can be produced by placing the upper eyelet in a position to the right or left of that of the lower eyelet as the case may be, instead of directly opposite. Complete reduction may not immediately follow placing of the wires, but will generally occur on taking up the slack of the connecting wires after 24 hours. A great advantage of this method is that if one wire breaks it can be easily replaced without disturbing the other eyelet wires. If the patient is to receive an anæsthetic, the eyelet wires may be placed before or during the operation and the jaws fixed with the connecting wires after the danger of nausea is past. The tie wires may be cut at any time in order to test the fracture. If consolidation is not complete the tie wires may be immediately replaced. The wires tend to loosen every few days, but can be easily tightened. The slight motion of the jaw due to loosening of the wires, as compared to the absolute rigidity of splints, is an advantage in the later stages of treatment, as it tends to stimulate bone regeneration. With the teeth wired in this way, the occlusion of the teeth is always under direct observation. Interdental splints usually cover the cutting edges and occlusal surfaces of the teeth, there often being a thickness of metal between them. The state of the occlusion cannot be observed during treatment, and when the splints are removed there may be considerable malocclusion. It is quite as easy, if not more so, to maintain cleanliness of the mouth with the wires as with splints. With attachment of the wires at three different points, the strain is well distributed and there is little tendency to loosening of teeth from this source.

In a series of over thirty mandibular fractures treated during the past year, this method of wiring was satisfactorily employed in all except two, regardless of the seat of the fracture. In one case, no teeth were present in the mouth, and in the other, an incomplete fracture at the angle without displacement, not even a bandage was required. This method necessarily entails locking the upper and lower teeth together, no matter where fracture is situated. But the disadvantage of this is not so important as the delay usually encountered in having a splint made.

When a tooth necessary as a point of fixation in one jaw stands alone and it is impossible to attach the usual eyelet wire, the attachment may be modified by twisting around the neck of the single tooth with eyelet on labial or buccal surface (Fig. 7).

Occasionally, a fracture of the body of the bone will be encountered in which molar teeth have been lost, leaving a long posterior fragment without teeth. In a case of this kind there is generally a tendency for the anterior end of the posterior fragment to be tilted upward by the temporal, masseter and internal pterygoid muscles, until the soft tissues covering the fragment meet the occlusal surfaces of the upper molar teeth (Fig. 8). To bring about reduction here, a piece of softened dental impression compound may be inserted to cover the gum over the posterior fragment, filling in the space between it and the upper molars, and allowing it to harden while the mouth is open (Fig. 9). The impression compound is then removed from the mouth, trimmed to as small dimensions as possible, and reinserted. The teeth on the large mandibular fragment are then wired in occlusion with the upper teeth, the impression compound at the same time keeping the posterior fragment down in place (Fig. 10). The compound may remain in the mouth for several days without change.

Ulceration of the gum overlying the posterior fragment sometimes is seen from pressure of the last upper molar. In this case it may become necessary to extract this tooth.

Roots of teeth encroaching on the line of fracture frequently give rise to infection sooner or later, and as a general rule the wisest plan is to remove them early, provided this can be done without too much traumatism to the fracture. However, in certain cases it may be advisable to retain such a tooth for a time even at the risk of infection. This applies to a fracture just in front of the last molar tooth, where loss of the tooth would mean upward displacement of the posterior fragment owing to lack of opposition from the upper molars (Fig. 11). After a week or 10 days of reduction, the posterior fragment will usually remain down in position and the tooth in line of fracture can then be removed (Fig. 12).

The method described of wiring the upper and lower teeth proves efficient for reduction and retention of over 90 per cent of fractures of the mandible met with in civil practice. For the occasional case, complicated by marked comminution or loss of bone substance, with destruction of teeth, in which fixation for several months may be required, the cast metal upper and lower splints, connected by removable lock-pins, are advised.

POSTOPERATIVE PERITONEAL ADHESIONS

An Experimental Study

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DURING the last 5 years we have made cursory observations on the formation of postoperative peritoneal adhesions following various operations within the abdominal cavity, and have tried out most of the procedures recommended for the prevention of adhesions. It is our purpose here briefly to give the results of these experiments.

The methods employed to prevent peritoneal adhesions may be divided into three groups: (1) prophylaxis, (2) foreign substances for the purpose of keeping the injured surface from contact with any other surface of the peritoneum, and (3) the retardation or inhibition of some element in the process of healing.

There is no doubt that the employment of prophylaxis, as emphasized by so many investigators of this subject, is the most important means at the surgeon's command of preventing adhesions. Whatever decrease there has been in postoperative adhesions can be attributed mainly to the development of better technique in which abuse of the peritoneum is obviated as much as is compatible with proper surgical procedure. The formation of peritoneal adhesions is a part of the process of healing, and in this respect should be properly guided by the surgeon and not necessarily prevented. In many operations, the formation of a certain amount of adhesions is desirable. In other operations, either because of absolutely necessary operative trauma or resulting pathological conditions, raw peritoneal surfaces are unavoidable and impossible to repair. Adhesions form on this base, and remedial measures only make the condition worse. A method which would prevent the formation of adhesions and yet allow normal healing would be of inestimable value in such cases. It was with the hope of discovery of such a method that our researches were conducted.

In attempting to prevent peritoneal adhesions, innumerable methods and substances have been recommended, for example: the stimulation of active peristalsis by purgation; change in the posture of the patient; various oils intraperitoneally, such as liquid vaseline and olive oil; fluid, such as normal salt solution; non-absorbable membranes, such as rubber dam, oiled silk, silver foil, tin foil, and collodion; absorbable membrane, such as catgut, cargile membrane, amniotic membrane, and fish bladder; viscid substances, such as glucose, dextrin, and gum acacia; various irritants, such as iodine and ether; and substances which will prevent the process of healing, such as sodium citrate and fibrolysin.

In attempting to determine whether any of the various methods or substances recommended are of value in the prevention of adhesions, it is necessary carefully to standardize the method of operation. We found this rather difficult since the reaction of the peritoneum varies quite markedly in individuals. There is also a great variation in species. The formation of adhesions in the rabbit is somewhat different from the same process in dog and in man. While we employed various species of animals, particularly the dog and the rabbit, we were convinced that conclusions applicable to man could only be drawn from the experiments performed on the dog. We also found it difficult to standardize a procedure involving the gastro-intestinal tract because of the wide individual variation in the formation of adhesions following trauma to this structure. After a number of observations, we found a technique which suited our purpose admirably.

TECHNIQUE

The operative procedures were carried out under complete anæsthesia and sterile technique. The liver was exposed and areas on each of the upper and lower surfaces were traumatized gently with dry gauze until bleeding occurred. We found that after such trauma on a dog's liver, adhesions between the traumatized surface and the parietal peritoneum on the upper side and the adjacent abdominal organs on the lower side always occurred. The material to be tested was placed over one of the traumatized surfaces of the liver. If the material was of any value, the result of preventing adhesions to the traumatized area was quite definite. The other traumatized surface of the liver was kept as a control, and it should be noted that adhesions never failed to occur. This gave us a procedure as nearly standard as could be hoped for.

After carrying out the foregoing procedure the abdomen was closed and after a definite length of time, at another laparotomy, the formation of

adhesions on the two surfaces of the liver was noted. In a few instances in which the material to be tested was not adaptable to this technique, various intestinal operations were performed and the material used over the line of suture. The latter experiments serve to emphasize the fact that the reaction of the peritoneum varies considerably in individuals.

RESULTS

Practically all the substances used to prevent peritoneal adhesions by keeping the injured surface from contact with other surfaces until healing takes place, can be included in three groups: (1) fluids, (2) substances which are absorbed, and (3) substances which are organized. We soon found that each group had some unsatisfactory elements. Fluids, such as sodium chloride, are hard to apply because they do not remain at the site of trauma, but gravitate to other portions of the abdominal cavity, depending on the position of the body. Substances that are absorbed, such as cargile membrane, may produce more reaction in the process of their absorption than the original trauma. Substances necessitating organization, such as rubber tissue and oiled silk, have the disadvantage of having to be removed subsequently.

Many of the procedures that have been recommended to prevent adhesions in man are not adaptable to standard laboratory conditions; we have, therefore, omitted some of them from our review. The list of substances actually employed under the standardized conditions, as described, includes paraffin oil, olive oil, lanolin, boric acid and lanolin, sodium chloride, iodine, ether, glucose, dextrin, silver foil, cargile membrane, catgut, and rubber dam. Our results in the employment of all these substances may be summarized by stating that our experiments did not develop anything of value in the prevention of adhesions. In many instances the substances were decidedly harmful.

As we have stated, the formation of peritoneal adhesions is a part of the process of healing, and it is questionable if it is ever advisable to interfere with the normal process. Sodium citrate is supposed to preclude the formation of adhesions by preventing the formation of fibrin and thus the process of healing. In our experiments it not only failed to prevent the formation of adhesions, but in some instances it seemed harmful, since the oozing of blood from the traumatized surface was prolonged.

After a careful consideration of the substances employed to prevent adhesions, it seemed to us that the value of such a substance would be enhanced, if, besides its usual attributes, it should liquidize slowly. The ideal substance to fulfill such requirements should have adhesive qualities that would enable it to adhere to the site of the traumatized area, thus keeping other surfaces from contact. The substance should dissolve slowly at body temperature and be absorbed from the general peritoneal cavity. The rate of dissolution should be such that the substance will protect the traumatized surface for several hours. It is almost needless to add that the substance should have many other characteristics, such as the possibility of sterilization, inert as regards healing, and the reaction of the peritoneum.

After experimenting with many substances, a mixture of gelatin and gum acacia seemed to furnish the desired characteristics. Both of these substances have been employed previously for this purpose. Gelatin seems to have been discarded because it irritated the peritoneum; acacia seemed to produce good experimental results, but was never given an extensive trial; the substances used separately have the serious objection of not adhering closely.

The gelatin and gum acacia were made into a solution in the ratio of 25 per cent of each to 50 per cent of water and produced a substance which differs in some respects from either of the mother ingredients. It has extraordinary adhesive qualities; so much so that at body temperature it will stick to practically everything, including the peritoneal surface. At room temperature it forms a tough membrane not unlike rubber. It is easily sterilized by boiling but does not remain the same after sterilization in the autoclave. At body temperature, it is a semisolid. The gelatin-acacia mixture, placed in the peritoneal cavity, sticks to the site of application, causes absolutely no reaction, dissolves slowly within from 4 to 8 hours, and is absorbed from the general body cavity.

THE METHOD OF PREPARING AND APPLYING THE GUM-ACACIA-GELATIN MIXTURE

The acacia should be obtained in lumps instead of in powder since the powdered preparation is not of a very good quality. It is powdered in a mortar and then dissolved in normal saline solution. An equal amount of gelatin is added and when both substances are thoroughly dissolved, the mixture is filtered through three or four thicknesses of gauze. The filtrate is then heated on the water bath until it is concentrated to the point at which the fluid content equals about 50 per cent of the mixture. While still quite hot the solution is poured into lead tubes of the type employed for tooth paste. After the tube is filled, the open

end is closed by folding until it is tight. The tubes are placed upright in a container with the screw-end down and boiled in water from 20 to 30 minutes. They are then removed from the water and dropped in a jar of 70 per cent alcohol which is kept tightly closed.

When applied at operation the folded end of the tube is grasped with a sterile hæmostat, held in hot water for a minute or two to liquefy the mixture, and then expressed at the desired site of application by simply unscrewing the top and rolling the closed end over the hæmostat. Care must be taken to keep the material from anything except the desired site, since its extreme adhesive qualities make it very difficult to handle.

SUMMARY

We have used the material in a large series of experiments and the results, on the whole, have been satisfactory. The traumatized surface of the liver heals well under the layer of solution. It would seem, therefore, that it has prevented adhesions, but bearing in mind the marked individual variation in the quantity of adhesions that may develop, we hesitate to state that it is of much practical value in their prevention. Furthermore, we have not as yet worked out a complete, satisfactory method of making and applying the mixture, so we do not recommend it to be entirely safe from the dangers of infection. We can, however, state definitely that of all the materials thus far advocated that we have been able to investigate experimentally, the gum-acacia-gelatin mixture offers the best chance for development. Our investigation of the various substances recommended for the prevention of peritoneal adhesions convinces us that surgeons are not justified in using them in the abdominal cavity.

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NEPHROTOMY AND DECAPSULATION FOR ANURIA, IN A CASE OF SINGLE KIDNEY; RECOVERY

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THE references in medical literature to nephrotomy and decapsulation in cases of single kidney are sufficiently few to warrant the report of this case.

The case of W. D. Minningham, operated upon by Dr. Ill, of Newark, was one of congenital absence of one kidney, in which nephrolithotomy was done for anuria of 23 days' duration. The patient recovered.

The case of Butler—an anuria of 13 days duration, due to an inspissated thrombus, incident to trauma of the left kidney—was not truly one of single kidney, as it was found at necropsy that the right kidney was present, but atrophic.

The case of Tracy—a recurrent anuria, due to a calculus which operated as a ball valve in the ureter of a single functionating kidney—is not, strictly speaking, a case of single kidney, as at previous operation only the lower pole of the other kidney had been removed.

In Minningham's case, one kidney was congenitally absent. In Butler's and Tracy's, both kidneys were present, although in Butler's case one kidney was atrophic, and in Tracy's, one was diseased.

The case here presented is, we believe, unique in that right nephrectomy had been preformed 4 years prior to nephrotomy and decapsulation on the left kidney.

W. B., white male, first presented himself for treatment November 6, 1916, at the age of 17 years, with the following history: It was ascertained from the mother that when the child was 3 years of age, he had a thick, purulent urethral discharge, which was permitted to go untreated, and after a time apparently subsided. Except for the fact that the child suffered from nocturnal enuresis until 9 years of age, nothing further was elicited during his early childhood.

When the patient was 13 years of age, he noticed that he was unable to control his urine, and began to wet the bed at night. He also noticed that during the day time when he was at school, his clothing was always wet. This was most uncomfortable and necessitated wearing cotton and pads to protect the clothing.

This condition continued for almost a year, when a physician was consulted, who passed a metal sound into the urethra. It is probable, that at that time a urethral stricture was present and the involuntary dribbling was the overflow of retention. He was instructed to return, probably for dilatation, but did not do so. He again came under medical observation in July, 1916, with the same symptoms, and was treated by urethral injection for three months without relief. During this time no attempt was made to explore the urethra.

The patient first presented himself to us (Dr. Leopold), for examination and treatment, on November 6, 1916, when the history above detailed was obtained. Abdominal examination revealed the bladder greatly distended, extending to above the umbilicus. All attempts to pass catheters in the urethra were unavailing; not even a filiform could be passed. The urine contained a trace of albumin and many pus cells.

The self-evident diagnosis of impermeable stricture at the bulbomembranous junction with overflow of retention, was made, and immediate operation advised. The patient disappeared and returned 2 months later with the same symptoms, having had no treatment in the interim. Operation was again advised and urged. He was admitted to the Jewish Hospital on January 30, 1917, and on January 31, an external urethrotomy, without a guide, was performed by Dr. Nate Ginsburg. He was discharged February 19, 1917, in good condition, with the perineal wound healed. The urine continued to show pus. Subsequent treatments of dilatation and bladder irrigations were carried out.

The patient did well until March 9, 1917, when he was seized with severe pain in the right kidney region, and constitutional symptoms of infection. Examinations of Dr. Ginsburg on March 12 revealed "a mass completely filling the right hypochondrium dorsally, extending ventrally to the linea alba, and below to the transverse umbilical line. Murphy's first percussion sign over the right renal region was positive." The right kidney was removed on March 14, 1917. The following are the notes made at time of operation: "Under ether anæsthesia, the patient in the recumbent posture, a Mayo incision was made over the right lumbar region, dividing the muscles across their fibers. The kidney was exposed after removing the peri-renal fat, and was found to be almost 11 inches from pole to pole. The pelvis was hugely dilated, and the ureter was dilated to a calibre of about 1 inch, besides being kinked and twisted. The kidney was removed after clamping the renal artery and vein, the latter two being then tied with 3 separate ligatures. The ureter was next clamped about 1 inch above the bladder, and tied with 2 separate ligatures, the stump of the ureter being cauterized with carbolic acid. A Mikulicz drain was placed next to the stump of the ureter, and extending from the lower end of the wound. The wound was closed in the usual manner."

Pathological diagnosis. Hydro-pyonephrosis.

Convalescence was uneventful, and the patient was discharged from the hospital on April 7. The urine was still full of pus.

From this time, until September 12, 1919, he remained in good health, able to do a full day's work, and had no symptoms. His phenolsulphonepthalein output in October, 1917, was 50 per cent at the end of 2 hours, in January, 1918, it was 35 per cent, and in June, 1919, it was 35 per cent. The blood pressure varied from 108 to 118 systolic. The left kidney was considerably enlarged and easily palpable. The urine continued to show pus.

On September 12, 1919, the patient had an attack of left-sided renal pain and a sudden rise of temperature. A diagnosis of pyelitis was made. There was prompt response to eliminative treatment, and he was able to leave the hospital in 6 days.

From December 27, 1919, to January 17, 1920, he was a patient in the University Hospital for treatment of chronic cystitis. Repeated examinations for tubercle bacilli were negative. Bacillus proteus was found in culture. For the following 6 months, treatment with irrigations of mercurochrome was continued in out-patient department.

On January 5, 1921, he was readmitted to the Jewish Hospital in an attack entirely similar to that of the preceding September. He left the hospital on January 18.

On January 27, 1921, he was readmitted in a third attack, during which he had anuria for 16 hours. He was discharged on February 11.

On February 18, 1921, at 1 a.m., he was suddenly seized with intense pain in the left kidney region. This persisted and on February 20, anuria developed. On February 20 he voided 1 ounce of urine at 10 a.m. and 1 ounce at 2 p.m. He was again referred to hospital. On February 21, he voided no urine. Catheterization revealed bladder empty.

On February 22, 1 ounce of urine was voided at 1 a.m. Cystoscopic examination by Dr. C. S. Hirsh revealed the bladder empty. A catheter passed into the left ureter met a high obstruction. On February 23, he passed 1 ounce of urine. On February 24, 1 ounce of urine, almost pure pus, was voided. Blood urea on February 24, 75 milligrams.

At this time, the patient was very toxic, and looked uræmic, although he was conscious and rational and had responded very well to frequent sweats. He was seen in consultation by one of us (Dr. Behrend), and immediate operation advised.

"Under nitrous oxide and oxygen anæsthesia, the kidney was exposed through an incision at the border of the ribs in the left loin space. The kidney extended almost 4 inches below the border of the ribs, was broad, and readily palpable, on account of its great size, its upper border impinging on the diaphragm. It was not delivered for fear of causing too much strain on its hilus, thereby endangering the blood vessels. The kidney could be inspected very easily through the incision. It was paler than normal and resembled the kidney of cloudy swelling. On account of the many symptoms above referred to, it was thought that there existed a pyonephrosis. A nephrotomy at the lower pole, and at the convex surface of the kidney revealed no pus, but instead there was a profuse outpouring of blood. A rubber tube was inserted through the opening in the convex surface of the kidney down to the pelvis. The kidney was stripped of its entire capsule. On account of the anuria, and on account of the cystoscopic findings, it was thought that the ureter was blocked; it was found greatly thickened and collapsed, but not obstructed."

The accompanying table shows the urinary output prior to and following operation, and the blood urea estimations during this time.

URINARY OUTPUT AND BLOOD UREA ESTIMATION

BEFORE OPERATION

Date 1921	Drainage	Voided per urethram	Total (in ounces)	Blood urea mgs. per 100 c.cm.
Feb. 20		2	2	
Feb. 21		0	0	
Feb. 22		1	1	
Feb. 23		1	1	
Feb. 24		1	1	75

AFTER OPERATION

Feb. 24	Lost	0	Several oz. (estimated)	
Feb. 25	12	0	12	
Feb. 26	40	0	40	
Feb. 27	37	11	48	54
Feb. 28	47	0	50	
Mar. 1	38	10	48	
Mar. 2	47	12	59	
Mar. 3	14	19	63	
Mar. 4	14	20	43	
Mar. 5	22	27	49	
Mar. 6	29	17	46	
Mar. 7	22	32	54	
Mar. 8	13	64	77	24
Mar. 9	11	47	58	
Mar. 10	Tube removed	54	54	
Mar. 11		47	47	
Mar. 24		Not recorded		13

At the present time, the patient's 24-hour urinary output varies between 50 and 70 ounces, his blood pressure is normal, and he has gained 10 pounds in weight since operation. The urine still contains pus, from which bacillus proteus has been isolated, and a vaccine made, which is being administered. The patient has resumed work, and is apparently in very good condition.

The sequence of events in this case, and the operative findings agree so closely with observations of Watson in his paper on anuria, that they are here briefly quoted:

"When the ureter is suddenly closed, as in the case of calculus anuria, the urinary secretion is very quickly arrested, a small amount only being formed, and accumulating above the point of impaction of the calculus.

"The kidney is enlarged owing to congestion and œdema of the organ which follow upon closure of the ureter, and increased intrarenal pressure thereby produced, and not because of being distended by accumulation of urine within it.

"Progressive destructive changes begin in the secretory elements of the kidney, soon after the establishment of the anuria, and, unless the obstacle be removed, continue, ultimately destroying the entire renal substance by a gradual aseptic process of atrophy if the kidney is not infected, more rapidly by suppuration if it is infected."

We believe that in this case, each attack, clinically pyelitis, with its attendant anuria of varying duration, was in reality a renal colic caused by temporary blockage of the ureter, assuming that such blockage might easily occur by extension from an obstinately chronic bladder infection.

In the three attacks preceding operation, the blockage was so temporary that the kidney did not become congested and œdematous, and shut down. In the last attack, it did, either due to longer urethral block as indicated by the cystoscopic report the day preceding operation, or to summation of insult. At operation, the ureter

was greatly thickened and collapsed, but not obstructed. There was no infection in the kidney.

SUMMARY

1. A purulent urethritis, acquired in some unknown manner, at the age of 3 years, and neglected, resulted in the formation of a urethral stricture, which manifested itself symptomatically at the age of 13 years.

2. Operation for impermeable stricture at the age of 17, followed in 6 weeks by right-sided nephrectomy for hydropyonephrosis.

3. An interval of reasonably good health for 4 years, except for chronic cystitis, followed by 4 attacks of left renal colic, the last culminating in anuria, in which 5 ounces of urine were voided in 100 hours, with the longest period of complete anuria, 35 hours

4. Impending uræmia, with a blood urea of 75 milligrams, immediately preceding operation.

5. Nephrotomy and decapsulation in a case of single kidney, with prompt re-establishment of the normal urinary output, and recovery.

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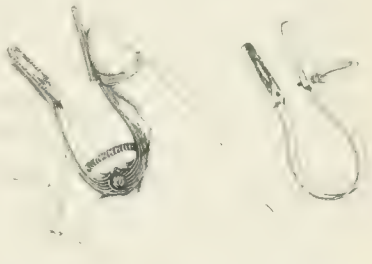
AN IMPROVED NEEDLE FORCEPS

By EMMET A. PRINTY, M.D., Chicago

THESE needle forceps were originally designed early in 1917, and the first model was described in the *Surgical Clinics of Chicago*, October 1918, vol. ii, No. 5. Various improvements have been made since then as can be seen by referring to the accompanying diagrams. The new instrument, perfected in 1919, is of heavier and more solid construction, the jaws are narrower and more tapered, and a spring and hinge have been added.

The forceps were originally made to use with straight needles, when doing gastro-intestinal suturing, but the new model can also be used to hold curved needles, especially when suturing the skin. It can be kept on the thumb ready for instant use and does not have to be laid aside when tying sutures. In pulling the suture taut the thread should be grasped between the middle and ring fingers to prevent pulling out the needle. It may be used by the assistant as a needle-puller.

The forceps have a definite field of usefulness, and after one becomes accustomed to them, they are found most convenient. The needle can be held at any angle in the forceps, and with practice the surgeon can hold the needle with them with practically the same ease as he holds the needle between the fingers, with the added advantage that when suturing resistant tissue the needle can be held more firmly and there is not the danger of tearing or puncturing the gloves. The surgeon who has been accustomed to holding curved skin needles in his fingers, upon trial finds that the forceps is most convenient and that he can obtain the same wrist action with it as with the needle in the fingers.



EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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PROLAPSE OF THE RECTUM

IT is very regrettable that the venerable term "Prolapse of the Rectum" is still much in vogue. It retards progress, and in a measure renders futile the search for an adequate treatment of a disease, which, to put it mildly, is nasty and extremely burdensome to the afflicted individual. To the surgeon initiated into the true pathogenesis of the malady, it is self-evident that prolapse of the rectum is only a variety of hernia, and in consequence its treatment must also be based upon all those fundamental principles, which underlie the treatment of hernia in other parts of the body. It is true that there exist certain very definite differences, which render the problem an extremely difficult one, and yet one not without interest and importance.

The writer has definitely shown in previous publications that prolapse of the rectum is a hernia which makes its exit superiorly through the cul-de-sac of Douglas and through that portion of the levator ani muscle, through which the rectum normally escapes from the abdomen to the periphery; this opening may therefore be termed the internal ring of the hernia and is analogous to the internal inguinal ring in an oblique inguinal hernia. In the course of its development, the hernia first invaginates the anterior wall of the rectum into the lumen of the gut, and when it has finally attained full size, it escapes from the pelvis at the anus; this may, therefore, be termed the external ring of the hernia, and is the analogue of the external inguinal ring in an inguinal hernia. Thus far prolapse of the rectum does not differ in its pathogenesis or pathology from any other hernia.

The first notable difference, and it is this feature which renders treatment difficult, lies in the fact that prolapse of the rectum is an exquisite example of that subvariety of hernia, which has received the name of "sliding hernia." It would lead me too far to describe at this place the pathology of a sliding hernia. I will, therefore, merely point out that the important characteristics of this hernia are, first, that it can occur only with viscera, that are only partially covered by serosa, and second, that the hernial contents, are not only hernial contents, but are also used up in the formation of the sac. If prolapse of the rectum is now studied from this aspect of the subject, it is readily seen that this particular form of hernia must be of the sliding variety, because only the front of the rectum is covered by peritoneum.

The second differential point, and one which this hernia shares with sliding hernia in the inguinal region, is the extreme difficulty in the operative treatment, and is further more accentuated by the fact that whatever operative measure may be undertaken for its treatment, must be carried out at the extreme depth of the pelvis, enhanced by the addi-

tional fact that, owing to the very presence of a hernial protrusion, the pelvis is of unusual depth.

The final and the most important difference between this and all other herniæ is this: that whereas as a rule in all other herniæ, the hernial coverings are of minor importance, and are ruthlessly discarded, in prolapse of the rectum, they are not only of prime importance, but, so to say, indispensable, because the rectum forms the most important covering of the hernia.

This pathogenesis of prolapse of the rectum can be readily proven at every operation, which attacks the problem in a rational and radical manner. It follows, therefore, that its cure must be based upon those principles which underlie the cure of a hernia in any other part of the body. It follows also that no operation is to be thought of which attempts a cure by a plastic operation upon the rectum, or by such operations, which attempt a cure by suspension of the sigmoid flexure. In fact no operation can be of value, which does not take into consideration the hernial sac, which after all is the most important and underlying element in the pathogenesis of the malady. Here, however, we are confronted with the problem, that the hernia is of the sliding variety, and that therefore, it is impossible to extirpate the hernial sac, as we are accustomed to do in hernial operations. After numerous failures in other directions the writer has finally arrived at the conclusion, that even the extirpation of the sac is not the most important problem. What is more important is its complete obliteration, in such a manner, that hernial contents, viz., small intestines and omentum, can no longer find their way into it. The writer has, therefore, evolved the idea of a complete obliteration of the pelvis, and he does this by circular sutures of an unabsorbable material (Pagenstecher's thread). In order to add additional support, an attempt is made to grasp in the sutures also the subjacent pelvic fascia.

It might be argued that this method of curing the hernia is flimsy, and hardly to be relied upon. In reply it can be stated that the conviction is growing in the minds of surgeons, that even in herniæ in other parts of the body, the adequate handling of the hernial sac is looked upon as one of the most important elements. Additional evidence is gained from the circumstance, that the operation is nearly always curative. At all events the pathogenesis of prolapse of the rectum, as previously outlined, is proven beyond peradventure; and no operation, however ingenious, can ever prove successful unless this pathogenesis is recognized. A. V. Moschcowitz.

INTRINSIC DERANGEMENT OF THE KNEE JOINT

IF a patient dies from peritonitis following a clean abdominal operation his illness has been short. It is the end, the patient is forever out of sight, and regrets are in vain. As time goes on, although not forgotten, details are dimmed and reminders are less acute. If, however, following the opening of a knee joint, an infection occurs, the patient usually lives through weeks and months of suffering and is finally saved, by free drainage with consequent ankylosis or by amputation, to stamp around the remainder of his days, a living, blatant example of a surgical disaster.

Before the days of Lister, the knee joint was looked on as forbidden ground, and this is a heritage that is hard to down. The rare but unfortunate infection of the knee joint that has developed in our modern hospitals, with the patient living and going through a heart-rending convalescence, has but served

to keep alive this distrust of the knee joint as a proper field for surgery. During the great war, ample evidence was presented that the knee joint has an appreciable resistance to infection. The mobilization advocated by Willems, when instituted early, after proper cleaning of the wound and institution of drainage, gave such astonishing results that we could no longer doubt. That the late cases, when infection was deep in the synovia and capsule, did not respond to drainage and motion, by no means disproves the claim. If the surgical technique that is essential to all surgery is observed, one need not fear exploring the knee joint any more than any other closed serous cavity of the body.

The semilunar cartilages rank first as a cause of mechanical derangements of the knee. The English literature contains many reports, notably by Rutherford Morison and Sir Robert Jones, of large series of patients operated on, but the American literature is scanty. This can be explained, partly at least, by the fact that games such as rugby and soccer are participated in by a much larger number of persons than in America, and also by the fact that in the mines in the region of Newcastle, where the condition is very common among the miners, the workers labor in low seams, which makes it necessary for them to squat on their heels with knees flexed and feet everted, a most favorable position for damage to the menisci. The fact that the internal cartilage is more often damaged than the external can be explained by anatomic facts. The internal cartilage is so firmly attached to the internal capsule that when caught between the bones, if the force continues, the cartilage will tear or fracture before it is torn from its moorings.

Rutherford Morison has described in detail many types of fractures but the so-called "bucket-handle" is probably the most common. This specific tear is a longitudinal rip in the middle portion of the internal cartilage, leaving the torn area attached at the anterior and posterior ends, the loop thus formed slipping into the intercondylar notch. Full extension is thereby prevented and the joint locked in slight flexion. A definite pathological condition as evidenced by a tear or fracture is almost invariably present when the derangement is due to the internal cartilage.

The external semilunar cartilage at its periphery is loosely attached to the capsule and this fact permits the meniscus a certain mobility and allows it to glide out of harm's way. If it is the cause of the derangement, it usually is found crumpled up rather than torn and is more apt to prevent flexion than to limit extension. The condition is usually a loose rather than a torn cartilage.

The primary derangements should be treated conservatively but repeated lockings with periods of disability make it necessary to resort to surgery. The X-ray is of no value as these fibrocartilaginous menisci cast no shadows. The procedure of injecting the joint with oxygen, thus throwing the fibrocartilages in relief, is too dangerous a procedure to warrant its use.

Loose osteocartilaginous bodies are also a cause of mechanical derangement of the knee, but the symptoms are more transient and the disability less than when the menisci are at fault. In numbers, they range from one or two up into the hundreds. Usually the patient has palpated them and often is able to force them out where the surgeon can also feel them. They are readily shown by the X-ray. Not infrequently, both joints are involved. They are of chief interest from the view-point of etiology. As a primary premise it may be accepted that trauma, direct or indirect, is a factor but not the sole factor in

their production. They may be grouped under three divisions. They may arise from the internal condyle just anterior to the insertion of the posterior ligament. A satisfactory explanation of this peculiar condition, seen only in the knee joint, has not been advanced, but Koenig, in 1887, offered the theory that it was due to blockage of an end artery and called the condition "osteochondritis dissecans." They may arise incidental to osteoarthritis. The marginal osteophytes or ecchondroses become chipped off and wander freely about the joint cavity and increase in size, obtaining their nourishment from the joint fluid. Occasionally the synovial membrane undergoes a peculiar change, becoming thick and pleated, forming bulbs which become osteocartilaginous on the tips, and, as they increase in size, drop off and migrate as free bodies. They take nourishment from the joint fluid, further increase in size, and may be so numerous that in palpating the knee, one is reminded of a sac of marbles. This condition is called "osteochondromatosis," and is not confined to the knee joint, but may be found in the elbow or shoulder joint. It suggests in some ways a benign neoplasm. Osteocartilaginous bodies rarely arise from the tibia or patella. Loose foreign bodies of extrinsic origin are of very rare occurrence in civil practice.

The incisions to be used in the removal of the causes of mechanical derangement are of importance because the joint cavity is not easily explored. When one of the semilunar cartilages is to be removed, either the internal, anterolateral or the external, anterolateral are to be preferred to any other. When a thorough search of the anterior compartment of the knee joint is to be made, the longitudinal split patella incision is the incision of choice. When the bodies to be removed are in the posterior compartment, the posterior, internal lateral or the posterior, external lateral incisions made with the knee flexed to a right angle afford ready access to a rather inaccessible region and even a fair degree of opportunity for visual inspection.

MELVIN S. HENDERSON.

GLAUCOMA

IN glaucoma, we are dealing not with a disease entity, but rather with a syndrome, the chief feature of which is increased intra-ocular pressure.

The question, "What controls the intake and outflow of fluids in the eyeball and thus preserves the normal intraocular pressure," has not yet been satisfactorily answered. Until this is known we are not in a position to understand why the pressure is increased.

A great deal of evidence has been offered to show that this increase of pressure has an anatomic basis and that it results from a blocking of the lymph circulation through the spaces of Fontana that lie in the pectinate ligament at the sclerocorneal junction. Most of the investigations of students of the subject, such as Weber, Knies, Priestley Smith, and Henderson are along this anatomic line.

Others maintain that the cause must lie deeper and may be looked for in increased secretion of fluids or of altered secretion of fluids by the ciliary processes, and that such increased or altered secretion may be influenced by degenerative changes in the structures of the eye, or may be the result of disordered metabolism. Whatever may be the cause of the increased intra-ocular pressure it is generally recognized that this is the dominant feature of the condition, the most immediate factor in the impairment of the function of the eye, and the one that best accounts for the clinical manifestations of glaucoma. It is, therefore, the one against

which therapeutic attack has been directed, on the assumption that if there is no increased intra-ocular pressure, there is no glaucoma.

The discovery by von Graefe in the middle of the last century, that iridectomy will reduce the tension of a glaucomatous eye has been the means of preventing great suffering and saving the sight of many who, without it, would have become blind.

The value of this operation is seen particularly in cases of the acute or congestive type, in which the anterior chamber is shallow and the root of the iris tends to block the filtration angle. But often the glaucomatous condition persists or recurs after such operation, however skillfully performed and surgeons have found it necessary to resort to other means to promote and facilitate drainage from the eye to maintain the proper pressure equilibrium.

Particularly is this the case in the so-called chronic or non-congestive types of glaucoma in some of which the pressure is not greatly increased, but which may go on rather slowly or insidiously to contraction of the visual fields and ultimate blindness. In these cases ophthalmologists use myotics such as eserin or pilocarpin, hoping by the contraction of the pupil to put the iris on the stretch and draw it away from the filtration angle. Also by this measure the spaces of the iris are opened up and are better able to absorb fluid from the anterior chamber.

If this treatment with myotics combined with general measures suffices to keep the intra-ocular pressure within normal limits, and the visual fields from contracting, operative treatment is by some regarded as unnecessary. But too frequently this proves to be false security, and the tension remains increased and operation becomes necessary. It has been found that in chronic cases iridectomy is not as valuable as in those of the acute or congestive type.

Various methods have been proposed and practised for securing artificial drainage of fluids from the eye and thus lowering its pressure, and the most important of these, aim to accomplish the result by some form of sclerectomy which on healing is supposed to leave a loose meshed scar, the "filtering cicatrix" through which the fluids of the eye will filter away into the submucous cellular tissue of the conjunctiva.

In this class of operations are the sclerectomies of LaGrange (combined with iridectomy), Herbert, Holth, and the trephining operations of Fergus and Elliot. In another class of operations, the attempt is made to insure a cicatrix more permeable to fluids, by incarcerating a portion of the iris in the wound of the sclera, this being covered by the conjunctiva. Such are the operations proposed by Herbert, Holth, and elaborated by Borthen in the operation of iridotasis.

The operation of cyclodialysis, separation of the ciliary body from its attachment to the sclera so that fluids may pass from the anterior chamber into the subchoroidal spaces, excited some attention years ago, but is not practised much now.

Quite recently a new thought has been advanced by Curran that in glaucoma, fluids cannot pass readily enough from the posterior into the anterior chamber, because of the close coaptation of the surface of the iris to the anterior surface of the lens. He endeavors to remedy this by a small iridotomy near the root of the iris; through this small opening the equilibrium of pressure between the posterior and anterior chambers can be re-established.

Indeed the operations that have been proposed for this deplorable condition are so numerous as to indicate that the perfect one has not yet been devised.

WILLIAM H. WILDER.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

Regular Meeting Held November 18, 1921, Dr. W. C. Danforth, Presiding

PRIMARY CARCINOMA OF THE FALLOPIAN TUBE

Dr. Joseph L. Baer: Mrs. H., age 53, entered the Michael Reese Hospital, on September 27, complaining of backache, frequent urination, constipation, and weakness, which had been present for the last 4 years and had been increasing in severity. General physical examination was negative except for a moderate, bilateral, cervical adenopathy. Bimanual examination showed the pelvic inlet to be filled by a globular mass, of grape fruit size, completely obliterating the cul-de-sac of Douglas. The uterus was crowded against the left superior pubic ramus. Pre-operation diagnosis: solid right ovarian tumor.

At operation the left tube and ovary were found normal. The uterus was atrophic. The right tube was bound down to a hard, white mass the size of a small grape fruit which was fixed by firm adhesions to the pouch of Douglas and to the posterior abdominal wall. The left tube and ovary were left *in situ* and the tumor, uterus, right ovary, and tube removed. The removal of the tumor was quite difficult, there was considerable bleeding, and a large denuded area was left in the pelvis. The sigmoid was used to block off the pelvis. Microscopic diagnosis made by Dr. Oscar Schultz: primary carcinoma of fallopian tube. The patient made an uneventful recovery and left the hospital in 14 days.

DERMOID CYST EXPELLED FROM RECTUM DURING LABOR

Mrs. F., age 25, III-para, admitted in labor. Patient had had one normal and one instrumental delivery. After the cervix had been completely dilated for 1½ hours and no progress was evident, the head being deeply engaged, forceps delivery was done. While extracting the head, a free mass the size of a man's fist, fell out through the anus. No rectal bleeding followed. The puerperium was entirely uneventful without any temperature elevation. The condition was encountered in a rather difficult forceps extraction and after getting the head down on the pelvic floor, I thought that there would be no further trouble, and went ahead with the extraction. The anus began to dilate when, to my horror, the whole rectal wall apparently began to show and prolapse. I had visions of a complete avulsion of the rectum prolapsing through the sphincter, but the perineum was intact, so I went ahead and the advancing baby's head continued to push this mass through the anal sphincter. Finally it proved to be a smooth-surfaced tumor which, in another moment popped out of the anal opening fully detached and free. It was a tumor of man's fist size, which proved to be a dermoid cyst with a little roughened surface at one point which was evidently the place of its attachment, somewhere. The patient made a normal recovery without evidence of traumatism along the lower bowel. The problem arises whence the dermoid. Dr. Schultz finds that the microscopic picture bears a resemblance to a dermoid of the ovary. Whether this was a sacrococcygeal dermoid which for long years had eroded its way through the posterior rectal wall and, after permitting two children to pass, was forced out by the delivery of this third child, whether it was an erosion into the intestinal canal higher up, or whether it presented an embryological cyst of the recto-vaginal septum I do not know. I came into the case when the head of the child was deeply engaged. Bimanually it was not revealed; there was no rectal prominence at all comparable to this apple-sized mass.

This complication is unique in my experience and in my reading, nor have I found anyone in the society or outside of it who ever encountered it before. Dr. L. E. Frankenthal has called my attention to a case reported in a recent number of the *Zentralblatt fuer Gynaekologie*, in which a fixed sacrococcygeal dermoid was an obstacle to delivery and was surgically removed to permit labor to be completed.

DISTURBANCE OF OVARIAN SECRETION, A PROBABLE CAUSE OF DEVELOPMENT OF HÆMORRHAGIC TENDENCY

Dr. Arthur H. Curtis: Very recently I operated upon a young woman of about 30 who had two chocolate-colored cysts of the ovary; one the size of a fist, the other four or five times as large. There was almost no ovarian tissue left in the cortex of these cysts. This patient had been under the care of Dr. Oliver S. Ormsby for more than 7 years. Every time the cutaneous surfaces of her body were bruised, ever so slightly, she developed a hæmorrhagic area, at times as large as a saucer.

The question arises as to whether the disturbed secretion of the ovary is an essential factor in the

development of the hæmorrhagic tendency. I wish to ask whether other members have encountered similar dyscrasias which might be ascribed to disturbances of the ovaries.

COMPLETELY CALCIFIED OVARY

This specimen was taken from a colored woman of about 44 years. The patient had a mass of fibroids the size of a child's head. On rectal examination, the mass was thought to be a calcified fibroid nodule, but upon opening the abdomen it proved to be a completely calcified ovary. The ovary was composed entirely of bone, was hollow in the center, communicated with the large bowel, and was filled with débris.

DIFFUSE ADENOMYOMATOSIS OF THE UTERUS

This second specimen shows a diffuse adenomyomatosis of the uterus. The uterus is about three times the normal size. Sections made at random invariably yield acini of glandular tissue.

FOUR CASES OF NEPHRECTOMY FOR VARIOUS LESIONS

Dr. W. C. Danforth: These four cases are shown, not because any of them represents anything of outstanding interest, but merely to emphasize the fact that in any service in which numbers of women are treated there are found at frequent intervals lesions of the urinary tract, and that it is the part of wisdom to be on the look-out for urinary pathology.

The first specimen is an enormous pyonephrosis. This woman was operated upon about a year and a half ago in a small town in Iowa, at which time a subtotal hysterectomy was done. At this operation the left ureter was evidently tied off, as upon cystoscopy I found it entirely impermeable from a point 3 centimeters above the vesical opening. When she arrived, the mass was so large that I did a nephrotomy for drainage to decrease its size, obtaining a considerable amount of purulent material of syrupy consistence from which we were not able to obtain any growth upon culture. Six weeks later, nephrectomy resulted in obtaining this very large kidney which was so densely adherent that in excising it, a hole was torn in the diaphram which was repaired immediately without apparently influencing the convalescence.

The second specimen is a large tubercular kidney containing many pus cavities. It was removed from a woman who, up to the time she was referred to me for diagnosis, had presented no symptoms whatever except a slight increase in frequency of urination which had been refractory to ordinary treatments. Cystoscopy showed the presence of many small tubercles and a catheter could not be passed up the left ureter. The right ureter was normal, the urine from the right kidney was normal. Tubercle bacilli, however, were found in the bladder urine which we assumed, therefore, must come from the left kidney. Nephrectomy was done by Dr. William R. Parkes, at whose request I did the cystoscopy.

The third specimen comes from an old woman who came to the out-patient department of the hospital because of frequent urination. Pelvic examination was negative and she was sent into the gynecological service for cystoscopy, the mass in the left kidney having been overlooked until that time. She was transferred to the surgical service for operation and a large carcinomatous kidney excised by Dr. Parkes.

The last case is that of an elderly woman physician living in a suburb west of Chicago and referred to me. Twenty-four years ago an enormous stone was removed from the left kidney, by Dr. Charles Adams. Ten years later nephrotomy was done, at which time two large stones were removed and the kidney drained. When she came to the hospital she had a large pyonephrosis and X-ray showed the presence of two enormous stones. We have, therefore, a formation of enormous stones in the same kidney in the same individual three separate times in 24 years. I have had one other instance of formal tion of a stone of walnut size one year after remova- of a stone from the same kidney.

CHILDBIRTH—PRIMITIVE VERSUS MODERN

Dr. C. Henry Davis, Milwaukee, Wisconsin, read a paper entitled: "Childbirth, Primitive vs. Modern" The paper was followed by a lantern demonstration showing labor scenes from Dr. Englemann's *Labor among Primitive Peoples*, and others to demonstrate modern delivery room technique as employed by the writer. (See p. 636.)

DISCUSSION

Dr. De Lee: I think that I ought to say a word or two on certain points, upon which I have always laid the greatest stress. My book distinctly instructs doctors and nurses that they are to disinfect the skin of the abdomen and the perineum thoroughly, but it must be definitely understood that only the immediate area around the vulva is to be considered aseptic. I consider this advice very important. If an infected surface is covered with one or two layers of cloth some surgeons think that they can then, with impunity, handle that sterile cloth. Two layers of cloth will not filter germs from an infected surface underneath, certainly not if wet.

For illustration, if you will magnify a piece of sheeting to the same degree of magnitude that will enable you to see a bacterium or coccus, you will see that it looks very much like chicken wire, and a germ will go through the interstices of the cloth as a fly will go through the chicken wire. You do not need a picture to prove that. And it is especially true if there is only one or possibly two layers of cloth.

Now, if those two layers of cloth are wet, then the capillary effect, or capillarity, will draw the germs through from the infected surfaces. Therefore, the

coverings of the legs, although sterile when put on, are not considered aseptic, and the only part that may be touched with safety, is the part immediately around the vulva, and the sterile towel over the belly which is frequently changed.

Regarding the covering of the anus we know that during delivery, the discharges from the anus sometimes come out with great force and if you put one or two layers of sheeting over that region, and then expect to handle the surface, you are running great danger of contamination from the anal discharges. Even with impervious rubber sheeting it is dangerous.

I have tried every method to protect the field against infection from the anus and find none that is entirely satisfactory. I believe that the best method is to watch the anus constantly and to catch the discharges.

The society may remember I have always held that childbirth is a pathological function. No one in his right mind would contend that pregnancy is a disease, but no one can deny that pregnancy and labor leave changes in the woman, and often the child, that are distinctly pathogenic. They are pathogenic and therefore pathological, and, in order that the people, the medical profession, and our legislators should give the science and art of obstetrics its proper place, it is necessary that every one should recognize the pathological dignity of this function.

That obstetrics has so far not attained the place in the general esteem it deserves may be learned from the paper of Dr. Davis. In 1835 Ramsbotham complained that he was not allowed to become a fellow of the Royal College of Surgeons of London, and a member of that College would not dare to be seen shaking hands with him on the street. As a mark of extreme courtesy to him because he was such a good and much sought after obstetrician, Ramsbotham was invited to witness a cæsarean section performed by one of the famous London surgeons. Fate would have it that the surgeon failed in his effort to deliver the child, and he had to call on Ramsbotham to turn and deliver it, whereupon the surgeon completed the operation.

Even today the obstetrician does not rank with the surgeon in the minds of the public nor will he until the full pathological dignity of obstetrics is recognized.

Dr. Rudolph W. Holmes: Dr. Davis mentioned that Philadelphia was the first American city to have obstetric teaching, which is true as far as systematic instruction is concerned, though the first full professor of obstetrics was Dr. Tennant of King's College, now Columbia College. Buffalo has the credit of being the city first to have clinic instruction. In 1750, James P. White gave the first clinical instruction before his class. He found a poor forsaken woman who had lodged with the janitor's family in the college building. Professor White was severely arraigned for the *indecent* exposure by members of the profession and the daily press. In the suit for libel instituted by White the defense had medical witnesses who maintained that no knowledge was acquired by the students from the exhibition, that the time for a doctor to learn obstetrics practically was when he entered practice. One testified that students watching a hen lay an egg could learn as much as watching the head come over the perineum.

Another thing: Doctor Davis made the statement that the sensorium of the modern obstetric woman has changed over a former period. I cannot accede to that. After reading the past literature covering obstetrics these last three or four centuries I doubt that a critical reading can substantiate the statement. Going back to *Genesis* we find that women bring forth their young in travail and pain; travail is not merely pain but excruciating pain. When we come down to more modern times, all the dissertations pro and con, concerning the use of chloroform in labor, by Simpson, shows that in spite of what one or the other said women suffered severely in the throes of labor. You know that Hodge and Meigs combatted the use of anæsthesia, at that time by the bald statement that the pains of labor were physiological and therefore had no necessity for their relief. The fact that Queen Victoria, the titular head of the Church of England, had chloroform employed when princess Charlotte was born did more to popularize the use of the drug than any other single factor. In more recent times, nothing has been written for or against the use of "twilight sleep" or the really scientific employment of nitrous oxide-oxygen, but what is merely paraphrasing the acrimonious debate centering around Simpson in 1847 when he began the use of chloroform. It hurts now to have a baby, and history shows that it always has done so. Some women have more fortitude than others but pain is there nevertheless.

Further I question if there has been any structural change in the anatomy of women going back to the beginning of time. I am not referring to changes incident to disease, as rickets or joint luxations, but purely in biological development. Of course, stature of different peoples show marked deviations of pelvic size, but as the infants born from peoples who are small are small there is no dystocia. Some time ago, in talking with a Philippino physician, he made the assertion that dystocia is relatively infrequent.

The rite of circumcision has been practiced for thousands of years, and yet the rite has had no influence on the biological development of the prepuce, it is just as redundant today as it ever was.

Dr. Taussig recently informed me that there is nothing to show that the conformation, or development, of the hymen has altered so far back as knowledge goes.

With the two above analogies I believe there is no scintilla of truth in the too oft repeated assertion that women today have more difficulty or more pain in labor than formerly, if we judge of normal women, not those suffering from acquired distortions from disease.

Dr. Thompson: I would like to add a few remarks in regard to obstetrics among primitive people. I

have had some experience in examining the women among the Ojibway Indians in northern Ontario. I have never seen a woman confined, but I have talked the matter over with the parish priests and they say that a full blooded Ojibway in northern Ontario never puts off a journey for childbirth, that they simply stop and have the baby by the side of the lake, put it in the canoe, paddle along and join the others. Injuries such as are known among the civilized people are scarcely heard of among those primitive people.

The mixed bloods are the ones that have the obstetrical injuries and diseases. When I used to go north on my summer journeys, an old halfbreed woman who was the Godmother or mid-wife to practically all the tribe in that country used to ask me every season if I would see a lot of the poor women that she had gotten together, knowing that I was coming to make a canoe trip, and we would examine these women who had obstetrical injuries just as we have in civilized communities. They had laceration of the perineum and cervix and injuries of the pelvic regions. I have never found these conditions in the full blooded indians. It has always been the case that the injuries were among the half-breeds, but the full bloods were peculiarly free and they were much more healthy and seemed to recover much more quickly after lying-in.

Dr. Carey: I should think it would be objectionable to cover up the rectum with sheets in the manner Dr. Davis speaks of, for it is impossible to keep the patient lying quietly during delivery and as during parturition there is more or less discharge of mucus from the rectum, I should think it would be impossible to keep the sheet from rubbing against the rectum and then up over the field. I would much prefer to have no sheet over the field.

Dr. Baer: Just a word in defense of the lateral position for delivery, which is our routine at the Michael Reese Hospital. We believe that exposure of the anal field lends itself much more readily to protection of the birth canal than any attempt at burying the anal orifice under sheeting or packing with cotton, the discharges from the anus down under the buttocks. Furthermore, we believe that we are better able to watch and guard the perineum and control and manipulate the head, with lateral posture than in the dorsal position as advocated by Dr. Davis.

Dr. E. Carey: I think, in defense of Dr. Davis' statement as to the more difficult labors in the present day, it is known that the mixing of the nationalities will increase the size of the head. It has been definitely shown that the Japanese who are about the only pure blooded race left in the world, very seldom, if ever, have any laceration. The pure blooded Marquesans also have very little difficulty as a rule. They usually take the baby immediately down to the river and wash it as soon as delivered; afterward plunging in for a swim themselves.

Regarding sheeting or the use of emergency draping, as Dr. Davis describes, I have found that it goes very nicely in emergency cases, but if there is anything to be done the sheet becomes contaminated with fæcal matter and moisture from whatever source, and as the patient moves the knees up and down, matter is smeared over the vulva.

Regarding the use of vaseline, I do not believe it is good technique. The perineum lying next to the anus, is more or less infected. If the perineum is covered with vaseline or glycerine the patient will perspire freely and bacteria may be forced with the perspiration into the vaseline, and the examining hand introduced through that vaseline into the vagina will undoubtedly cause some of this vaseline to adhere to the inside of the vagina, and this may lead to infection of the birth canal.

Dr. Davis: I appreciate the points brought out in the discussion of my paper. As regards delivery-room technique it should be remembered that my patients all have obstetrical analgesia and with rare exception lie quietly and do as they are told during delivery. The surgical cleansing is accomplished when the head is on the perineum. After the perineal area is cleaned, the pores of the skin are sealed with sterile glycerine as a rule, but vaseline or liquid soap may be used. The abdomen is covered with a sterile towel, and sterile towels are fastened around the thighs above the perineal stockings. The hips are elevated about 6 inches with the inclined hip rest for the perineal stage of labor. This is my first material deviation from the usual technique described by Dr. De Lee in his textbook. When the head is on the perineum I add the sterile sheet which is draped over the thighs and pressed down to expose the vaginal opening. It does not come in contact with the perineum at this time. A primary posterolateral episiotomy is now made. The sphincter ani is already dilated by rectal examination. I favor episiotomy for most primiparæ and multiparæ who have not been neglected following former labors. Formerly I used the medium episiotomy but following three complete tears, one with a persistent posterior and two with rather large aftercoming heads concluded it was safer to direct the cut somewhat to the left side of the sphincter. The complete tears were repaired at once with perfect results in two cases and fair in the third.

My patients are given a light anæsthesia with nitrous oxid oxygen for the episiotomy and a deep analgesia for delivery of the head. Ether is added when indicated. The deep analgesia is used for most mid and low forceps deliveries. The episiotomy is repaired under a gas-ether anæsthesia. I bury plain catgut and close the mucous membrane and skin with chromic catgut. In a few cases black silk is used for the skin. When care is used to avoid dead spaces and strangulation of tissue from drawing the sutures too tight, there should be a perfect restoration of the perineum.

Could Dr. De Lee or Dr. Carey see a patient delivered under obstetrical analgesia with this technique, I believe they would agree that when the patient is quietly working according to directions,

my changes in technique are not open to the question they have raised.

With Dr. Holmes, I agree that childbirth has always been accomplished after more or less suffering. Even the lower animals show mute evidence of suffering during parturition. Yet the modern woman through mixing of races has a harder time with an increased amount of dystocia. Dr. Thompson has emphasized this from his observations of the Northern Indians. It has long been recognized that an Indian woman pregnant by a white man is apt to die during labor unless assisted by a medical man. Furthermore, women of today are less able to stand the nervous shock of labor pain, and I believe we must do everything possible to control and alleviate this pain.

HYPEREMESIS GRAVIDARUM

Dr. Charles E. Paddock read a paper entitled: "Hyperemesis Gravidarum." (See p. 633.)

DISCUSSION

Dr. J. L. Williams: A quantitative study of the chemistry of the blood in hyperemesis gravidarum reveals a marked increase in the concentration of uric acid. In addition to the seven patients previously reported before this Society there are five others with a true pernicious vomiting of pregnancy in whose blood the uric acid was in high concentration, the average amount being 6.34 milligrams per 100 cubic centimeters during the period of maximum toxæmia. The maximum and minimum range was 10.15 to 4.14 milligrams per 100 cubic centimeters. In three of these patients the values dropped to normal after delivery and in one which Dr. Paddock has reported tonight the amount of uric acid in the blood returned to normal following the treatment as outlined although the concentration in the blood of this patient was the lowest of the group. One of these patients, whose symptoms were very pronounced, had a marked retention of non-protein nitrogen substances other than uric acid in the blood. At the period of maximum toxæmia in this patient, the blood urea nitrogen was 107.75, the total non-protein nitrogen 147.4, the uric acid 10.15, the creatinine 3.8 milligrams per 100 cubic centimeters. After therapeutic abortion was performed, the values for all of these substances promptly returned to normal. In another patient the uric acid and other waste nitrogen products were markedly diminished several hours after the intravenous injection of corpus luteum extract.

The outstanding fact that delivery or operative removal of the uterine contents is followed by a return to normal of the concentration of the uric acid of the blood suggests the possibility that by absorption the amniotic fluid may be the source of the increased amount of uric acid in the maternal blood. The amniotic fluid of the patient whose blood contained such a high concentration of waste nitrogen, had 30 per cent more uric acid in it than had the maternal blood.

In all patients with true pernicious vomiting there is a moderate acidosis as evidenced by the depression of the alkali reserve below the level for normal pregnancy. In starvation there is said to be an acidosis clinically. I have examined the blood of one patient dying of starvation caused by duodenal carcinoma and it contained only a moderate increase in waste nitrogen and 4 milligrams of uric acid per 100 cubic centimeters.

Dr. Milton M. Portis: I have had a very limited experience in the treatment of hyperemesis gravidarum. I have seen an occasional case, and the particular case that Dr. Paddock mentioned is one that I followed more closely in detail. In my work, of course, I have seen a great many cases of vomiting. The vomiting in some is due to intestinal obstruction, and they are given immediate surgical treatment. But in the majority of cases the vomiting is not due to a surgical condition and these it has been my lot to treat.

In the early days we used rectal alimentation but it was entirely unsatisfactory after the first few days. The bowel does not absorb but a very few things. It will take water in quantities; it will take glucose and alcohol. But beyond that, if you are at all interested in studying your cases given nutrient enemata, you will find that you get back practically all you put in the bowel.

We worked a good many years in trying to get around this but without success. When Einhorn brought out his duodenal tube in 1909 I, for one, hailed it with a great deal of joy. It had solved a big problem and I do not know of anything I have seen of greater value. The first work done with it was, however, very difficult. Einhorn fed with a little syringe that sometimes worked and sometimes did not. At last I modified it and tonight I will show you an improvement I have been using for the past 7 or 8 years that I think is a better type for feeding. It is simplified very much from the feeding standpoint and from the nursing standpoint. It is not a very difficult thing to learn, but it does require some good technique. There are a lot of tricks you have to learn to be entirely successful. The patient doesn't like it and you have to get the patient's confidence. But all the patients, when they get the prompt relief from the vomiting and nausea and begin to feel that they are being fed, would rather have the tube down than to have it out.

I remember the patient that Dr. Paddock mentioned, who asked to have the tube put back in again when her symptoms returned. And I have known that to be true in a number of cases.

I won't take up any time in talking about the various theories of the etiology of hyperemesis gravidarum. There is no doubt in my mind that there is a great big psychic element in this trouble. I am convinced of that from the type of patients we see, and from the results obtained in giving the patient something out of the ordinary. But, as Dr. Williams has said, there is a definite blood change found in a number of cases, and that the patient can

not imagine. There is no doubt at all that there are changes in the blood chemistry in the patients I see without pregnancy who go on vomiting and become dehydrated and more or less weakened by the lack of food. Whether this toxic picture is due to the demonstrated blood changes I do not know, but the fact remains that we lose patients who are not pregnant if we allow them to go on with just the type of thing you see in pregnancy.

I remember very well, in the days before we had the duodenal tube, a healthy young woman of 16 years, with a peptic ulcer, who went on vomiting in spite of all the measures we used. I have never forgotten the desperate days we had in trying to feed that girl and in trying to keep her from dying. In her case the urine was perfectly normal at the start.

With your permission I will ask Dr. Sidney Portis to demonstrate the apparatus we use and explain the details.

Dr. Sidney Portis: For ordinary purposes of inserting the duodenal tube a patient must have a fasting stomach of 12 hours' duration. The tube is inserted back into the pharynx. The patient is told to swallow a little cold water and at the same time use gentle force to aid the swallowing of the tube. This swallowing is kept up until the "stomach mark" on the tube is reached. One may experience some difficulty at first, not only in the initial passage, but while the olive is going down. In order to overcome the "gagging" sensations the patient is told to take deep breaths and thus overcome this difficulty.

The patient is now told to lie on the right side and very gradually swallow the tube to the "duodenal mark," and then to continue to swallow until the mark designated on this tube, which will put the olive way beyond the duodenum. This little stop cock is closed and if the patient has an empty space from an extracted tooth, the tube is fastened into it by means of dental floss. If there is no empty space then the tube is fastened behind the last upper molar and the protruding end fastened to the cheek by means of a piece of adhesive. A string is attached to the stop cock and by means of a safety pin it is fastened to the patient's gown.

The patient continues to lie on the right side the rest of the night to facilitate carrying the olive on downward into the small bowel. The next morning, with the aid of a large Luer syringe a small amount of air is put into the tube in order to expel small plugs of mucus. Then by means of gentle suction the duodenal contents are aspirated.

If the tube is in the duodenum or beyond, a light yellow to whitish fluid is returned, which shows an increased viscosity when dripping from the tip of the syringe. If the fluid comes back very readily and it is thin and contains mucus, it has been my experience that it is in the stomach. The duodenal contents are much thicker and usually bile-stained. If one is still not certain the tube is in the duodenum, the patient may swallow a small amount of milk, and if the milk does not return the olive is not in the stomach.

With the tube in place the feedings may be started. As a matter of routine, before and after the feedings, two syringefulls of water followed by one of air are inserted in the tube. This will insure the patency of the tube and olive.

By means of this thermos bottle and Murphy drip apparatus, the feedings are given over a period of 20 minutes or more. In order to insure that there are no curds of milk after peptonization, the fluid is strained through several layers of gauze. The milk is then diluted with an equal amount of water, so that it flows very readily. The feedings are kept up every 2 hours.

One may also give medication by the same route. This feeding is kept up as long as deemed necessary and then the tube is gently withdrawn. When the olive again reaches the pharynx the patient makes a swallowing movement and the tube is quickly "jerked" out. This causes less discomfort to the patient.

Dr. Milton M. Portis: I am glad Dr. Bacon mentioned the fluoroscope. It should be used when there is any doubt at all. By putting a little barium through the tube you secure the best results. As the barium comes out you can see it in the bowel. If it comes into the stomach it spreads over such a large surface or area that you can determine where it is without question.

I did not want to give the impression, and I do not think my brother did, that there is any discrimination as to what should go through that tube. You can put in anything you want to. Give as much of the carbohydrates as you choose, or glucose or anything else you want. All types of medication can be put through the tube and you can give fruit juices in any amount; laxatives from milk of magnesia to castor oil; or anything you choose may be given. The patient does not taste it. You can give anything you want so long as it is in liquid form and easily pushed through.

Dr. De Lee: A year ago Dr. Paddock told me about the duodenal tube feeding and since then I have used it in three instances. In two of the cases we were successful in getting the tube beyond the pylorus, but the toxic condition of the woman continued and we had to empty the uterus. One of the women received enough fluid through the tube so that she became œdematus. That showed us that we could introduce large amounts of fluids by means of the tube, but in spite of the introduction of the fluid and food, the toxic condition continued and the woman very nearly lost her life.

The second case was a physician's wife. The tube remained in place for 24 hours. We gave her plenty of fluid and food but she vomited alongside of the tube. We used the tests Dr. Portis makes and believe that the tube was in the duodenum.

In the third case, Dr. Portis had an opportunity to pass the tube but he couldn't get it through the pylorus, and the nurse under his instructions, which were carried out to the letter, likewise could not get it beyond the pylorus.

Nevertheless, I doubt not that this is going to be a very great addition to our future handling of ordinary vomiting in pregnancy. It has the double advantage of the psychic influence and also the supplying of food, but the toxic cases will go on to death in spite of these.

I had one very sad experience lately, in which we fed the woman for several weeks. We were under the impression that she was improving because her vomiting was reduced, and she showed signs of gaining. She had plenty of liquid and her weight was not being very much reduced. Her blood picture on several instances was normal, and yet the toxæmia continued in spite of these very favorable signs. All of a sudden, she took a turn for the worse, developed an acute polyneuritis and died in 3 days. Her alkali reserve was good, her water balance good, and she got enough calories to keep up strength and they were sufficient to keep her alive, but in spite of all that, the toxic condition continued. Therefore, I would add a little word of warning in the use of these remedies, which in a way, blindfold us to the actual toxic state underneath.

Dr. N. Sproat Heaney: First, I should like to ask Dr. Paddock if the nausea disappeared along with the vomiting upon the introduction of the tube, or whether the nausea persisted with the use of the tube.

I fear that we are liable to make certain deductions from the blood chemistry in these conditions which are not justified.

Dr. Williams has mentioned that in these cases of pernicious vomiting the uric acid concentration is high. He also stated that in a case or two where the pregnancy was interrupted, the uric acid concentration of the amniotic fluid was also high and suggests that there is a relationship between these two conditions. Dr. Williams also mentioned that in the cases of Dr. Paddock's in which the patients were relieved by the use of the duodenal tube, the uric acid concentration of the blood fell to normal. Dr. Portis states that in his cases of neurotic vomiting where there is no pregnancy at all, the uric acid concentration is also high, while Dr. Williams states that in a case dying from stricture of the duodenum, the uric acid concentration was unchanged.

Now I deduct from these facts that the uric acid concentration of the blood may be secondary instead of a primary condition, and is dependent upon the fact the patient is in a starving condition from vomiting and that the acidosis and blood chemistry picture are dependent upon this fact and not upon the fact that the patient is suffering from an intoxication of pregnancy *per se*. If a patient comes almost to the point of death from vomiting when she is not pregnant and has the same blood chemistry as a patient with hyperemesis gravidarum *in extremis*, we certainly could not say that a placental condition produced the uric acid concentration. If the blood chemistry is altered, we would also expect all the fluids of the body to be altered, and therefore it seems natural to expect that the amniotic fluid would also have a high uric acid concentration. I am not sure, but I suggest that we may learn that the blood picture is a condition secondary to the vomiting instead of being associated with the cause of the pernicious vomiting.

Not of scientific importance, but of the very highest clinical importance is the fact that for the last few years the only cases of hyperemesis gravidarum that I have seen have been in doctor's wives and in nurses.

Dr. Seipel: Several years ago I had an acute case of hyperemesis gravidarum and in looking up the literature I came across an article by Dr. Werthein in which the hereditary influence was mentioned and on that point I want to bring out a feature in my patient's history. Her mother had been pregnant six times, and in each case there was a very severe case of hyperemesis gravidarum.

Dr. Bacon: We cannot get away from the discussion of the cause of hyperemesis gravidarum, but it is questionable, of course, whether the chemical study of the blood may lead us to some better knowledge of it than we have now. A few years ago J. Whitridge Williams thought that he could determine the toxic cases by finding the ammonia coefficient. Now we know that a high ammonia coefficient may result from starvation.

And so, with the present condition of the etiology it is evident that besides treating the patient psychically and symptomatically, the one thing to do is to feed the patient. It is unfortunate that we cannot succeed in feeding the patient by rectum in every case. No doubt, very much can be done by proper rectum feeding by the use of only those substances that are absorbed from the rectum such as glucose and alcohol and not trying anything else, and by proper treatment of the rectum and by using local sedatives, if necessary.

But, if we can, by the use of the duodenal tube get liquids and even those two foods, glucose and alcohol, into the system we are doing very much and we do not have to bother for a few days at least, with milk or anything else, and it seems to me that it would be better as a point of technique to adhere simply to foods that would not stop up the tube.

I can hardly understand why, in a desperate case like this you would care to give very much more than that to the woman. Evidently the technique is very important. I have talked with Dr. Smithies who has used the duodenal tube a good deal and he informs me that he succeeds very often, when the introduction of the tube is difficult by using orthoform in the stomach and producing a partial anæsthesia which assists in the introduction of the tube. Moreover he also determines the presence of the tube by the use of the flouroscope, and I suppose that would be an important part of the technique.

Dr. E. Cary: In discussing this question, etiology seems a little out of form this evening; however, unless the treatment is considered from a sound etiological view-point, it needs must fail in its ultimate aim.

Lockhead and Cramer, as far back as 1908, pointed out that one of the chief functions of the placenta is to store glycogen and that most of the fats formed in the fœtus are derived from that source.

Mottram, in 1909, found a glycogen deficiency in the livers of ill-nourished, pregnant animals, and in 1921, in the *Lancet*, Harding states that the causative factor in vomiting of pregnancy is a lack of sufficient glycogen in the liver, or, in short, a carbohydrate deficiency which he has proved results in a fatty infiltration of that organ.

This carbohydrate deficiency, as pointed out by Woodyatt in his exhaustive work on diabetes, interferes with the combustion of fatty acids and results in the production of acetone bodies and an acidosis. Silberstein, of Munich, in 1912, and Blodgett, of New York, in 1915, called attention to the acetone found in the urine of children suffering from cyclic vomiting, and Grulee, of Chicago, states that this condition may best be combated by feeding large quantities of sugar. Chalfant, in 1912, also noted that the liability of vomiting in postoperative cases was increased if acetone were present in the urine.

Constipation tends further to embarrass the liver by adding more toxins, and Alvarez, in 1919, has shown by X-ray that plugging of the lower bowel produces reverse peristaltic waves that reach even to the stomach and œsophagus.

Now, in order that our treatment in vomiting of pregnancy may be founded on rational principles, we must consider primarily, a carbohydrate deficiency, an acetonæmia, an acidosis, and constipation. Harding has shown that fatty infiltration of the liver in laboratory animals has followed relatively short periods of starvation and considers this of paramount importance.

For centuries the vomiting of pregnancy has been termed "morning sickness" and this in itself should be significant. Why is vomiting so prone to occur in the early morning? Because it is a time immediately following the longest fasting period of the 24 hours and when the depletion of glycogen in the liver is greatest.

Therefore, the most logical treatment, it would seem, would be to supply an abundance of carbohydrates in the diet several times a day; neutralize the acid condition evident by urinalysis and correct the constipation. This I have endeavored to do in my cases with signal success.

Dr. McKee: Dr. Paddock did not mention the severe vomiting that continued throughout the pregnancy in the patient who happened to be my wife. The vomiting commenced 10 days before the first period was missed. That answers in part Dr. Heaney's suggestions as to the neurotic element. Another point, the nausea was not relieved with the relief from vomiting in this case. It was the last thing to disappear. However, at the present time the more frequently the patient eats the more comfortable she is and she is in better condition now than she was during the first pregnancy. In other words since she has recovered from this severe siege she has continued to improve. At the time of delivery the patient weighed 90 pounds but soon reached 145 pounds, showing how rapidly she recovered. I do not know whether it has any bearing whatsoever on the subject but at present the patient voluntarily chooses sweet foods and digests candy with the greatest degree of comfort.

Dr. Paddock: I hope I made it clear that the duodenal tube is of great benefit in the treatment of many cases of hyperemesis gravidarum, perhaps not in every case. With the tube well into the duodenum there will be no vomiting and I am sure that in the case reported by Dr. De Lee the tube had not passed the pylorus.

There are, undoubtedly, cases of severe vomiting in pregnancy which only the termination of the pregnancy will stop and possibly that treatment will not succeed. Loss of weight with dehydration of the tissues is a warning sufficient to put the physician upon his guard that the case is becoming a very serious one. Do not wait until all other treatment has failed and the patient is in a desperate condition. The tube can be retained for days or weeks with no discomfort to her. Dr. Portis has told you how simple it is to pass the tube and the kind of nourishment to be passed through the tube.

To one of my patients we gave during the first 24 hours 86 ounces of nourishment, mostly peptonized milk and glucose. The next day she took 108 ounces of the same, with the addition of egg.

Every recognized treatment for hyperemesis gravidarum has been tried in each of my reported cases before resorting to the use of the duodenal tube and in each of these cases had I followed my usual procedure I would have emptied the uterus. One of the patients was in such bad condition that I am sure had I done so I would have lost her. Even when the cause for the vomiting has been removed, as for instance the correction of a retroverted gravid uterus or any mechanical irritation removed, duodenal feeding may be of great service in quickly overcoming the dehydration and starvation.

I am sure we have in the use of this agent a valuable addition to the other means of treating our cases of severe vomiting in pregnancy.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN GYNECOLOGY AND OBSTETRICS

By GEORGE GELLHORN, M.D., F.A.C.S., Saint Louis

HERO worship is, in a way, a wholesome thing. It inspires the young and it stimulates the mature. As a nation, we Americans have all too little of it. We criticize our leaders while they are alive, and we forget them as soon as they are dead. Washington and Lincoln are notable exceptions; but who thinks of Hamilton or Grant, who speaks of the man who invented the cotton gin, who built the first locomotive, who constructed the first steamboat? Among physicians the memory of medical heroes is pitifully short-lived. Since we have transferred our instruction to students almost altogether from the lecture room to the bed side, there is no time to dwell on the evolution of our science, and where is there in our universities a chair for teaching the history of medicine? It would be an interesting, but probably a disappointing experiment to inquire from a group of physicians what Ambroise Paré had done to achieve immortality; what we owe to a Harvey, a Virchow, a Koch, a Pasteur; why mankind is in debt to Oliver Wendell Holmes and Ignaz Semmelweis. In the absence of systematic teaching of history in medical schools, essays or books on historical subjects fill a real need and should receive a hearty welcome. This applies pre-eminently to a new book by Schachner which is devoted to one of the greatest among our medical heroes, to Ephraim McDowell,[1] whom America proudly shares with the world. The author has set himself the task of protecting from indifference and oblivion the memory of that courageous practitioner in the small frontier town in Kentucky who, in 1809, performed the first ovariotomy and thereby ushered in a new era of surgery. If we consider that the most brilliant exhibition of surgical skill and judgment of today rests upon the cornerstone daringly laid by McDowell more than a hundred years ago, we must needs applaud the author's desire to establish in the hearts of the medical profession a proper appreciation of this great benefactor of the human race. Patient and painstaking investigations which show clearly that they have been a labor of love, have enabled the author to present the life and work of his hero in greater completeness than it has ever been attempted. Sidelights upon general and medical conditions of the times prove to be most interesting, and a separate chapter devoted to Margaret Crawford, the heroine of that great historical event, appeals to us as a highly sympathetic document.

The make-up of the book is excellent and adds its share to the prominent place the work should occupy both in public and private libraries.

DO American physicians fully realize that the modern art of medical illustrating originated in this country and in our own days? Art there was—highest, noblest art—when Vesalius, Albrecht Duerer, and Rembrandt and their contemporaries drew or etched or painted anatomical subjects. But in the centuries following less and less attention was given to the subject of medical pictures until the task of illustrating medical works was, with but occasional exceptions, left to mediocre talent and we have only to remember our text books as late as 1900 to recognize how insignificant a part pictorial art played in the education of the student. A very important change took place in 1899 when Howard Kelly's *Operative Gynecology* appeared adorned with illustrations of an heretofore unknown excellence. The illustrator, Max Broedel, a young art student recently from Leipzig, brought to his work not merely superior skill but also the accuracy of a genuinely scientific observer, and he at once set a standard that had since been equalled only by a few other artists and excelled by none. Another significant development occurred recently, and likewise in this country, when a chair of the relationship of Art to Medicine was endowed at Johns Hopkins University; and it is there that Max Broedel, the first incumbent of this new professorship, is conducting a training school for competent medical artists.

All this, of course, is not a book review. Rather it is a trend of thought which is called forth by reading a French manual of obstetrics,[2] which by its fourth edition, has sufficiently demonstrated its practical value to generations of medical students. In contrast, however, to the conciseness of its text which leaves little room for criticism, the inadequacy of its illustrations is very apparent, and as teachers we can not insist too strongly on the importance of instructive pictures as an effective aid to the spoken or printed word.

[1] Ephraim McDowell, "Father of Ovariotomy" and Founder of Abdominal Surgery. By August Schachner, M.D., F.A.C.S. Philadelphia and London: J. B. Lippincott Co., 1924.

[2] Éléments d'Obstétrique. By Dr. V. Wallich. 4th ed. Paris: Masson et Cie., 1924.

THE intimate relationship between gynecology and obstetrics is well demonstrated in a book[1] which has just come to us from England. Fairbairn, with the help of numerous contributors, presents the entire subject of obstetrics *and* gynecology in *one* rather large volume. Of these contributors, there are quite a few whose names are well-known and honored among us—Ballantyne, for instance, and Eden, Kerr, Whitehouse, Berkeley, Bonney, Jellett, Lockyer—and we are glad to greet the others, feeling from their contributions that the future of our specialty in England is safe in their hands. Where so many writers co-operate, it is impossible to avoid a certain overlapping and repetition, but on the other hand there is in all such collaborations a free expression of individual opinions by which the reader can only gain.

The book is divided into seven large parts. The first of these, entitled "Life History of the Female Reproductive Organs" contains anatomy and physiology and forms the common basis for the succeeding parts. There follow two sections devoted to normal and abnormal reproduction (with an additional part dealing with the infant). Obstetrics, thus, comes first, not only because of its antiquity as contrasted with the extreme modernity of gynecology, but also because no one who has not been through the obstetric mill, can have the judgment demanded by many of the problems presented by the diseases of women. Next in order is the section on diseases of women with numerous chapters and subheadings. It is very pleasing to note that the editor has abandoned the customary anatomic grouping which is decidedly unsatisfactory for purposes of study but has, instead, classified the subject according to diseases wherein the localization in one or the other of the organs and tissues is merely incidental. Such a classification has its obvious advantages as one reads the chapters on, let us say, mechanical lesions or infections. The next section on "Gynecology in Relation to Public Health and Industry" is an expression of the tendency, especially marked in recent years, to think in terms of the community, and not of the individual patient alone. Some of the subtitles, such as "The Rôle of Obstetrics in Preventive Medicine," "Maternity and Infant Welfare Centers," and "Industrial Occupations and the Health of Women Workers," indicate the highly commendable innovation instituted by the editor. The final section deals with operations and other therapeutic procedures, both in gynecology and in obstetrics.

So much for the subject matter, to which may be added that this enormous amount of material has been disposed of in less than 950 pages. But aside from the excellence of the essays presented, the great significance of the work lies in another direction. Several authors, in the past, have written separate textbooks both on gynecology and obstetrics for instance: Hirst in this country; Doederlein, Hofmeier, Fehling in Germany; Berkeley and Eden in England. A few writers have presented the two subjects in *one* volume. Schauta, of Vienna, did it about 25 years ago, and, before him, Peter Mueller, of Berne. But that was at a time when the two subjects had not attained their present expansion. There was an attempt made by Liepmann, of Berlin, to close the gap between the two sister sciences, but unfortunately the war intervened when only two of the projected five or six volumes had been published. It is, therefore, a matter of gratification to see that this laudable idea has been carried out by Fairbairn in so satisfactory a manner. He has clearly recognized that the term "gynecology" in its wider and truer sense means *all* the functions and anomalies of the female reproductive organs and, therefore, includes the phenomena of pregnancy and labor. If there is any criticism to make it is this that only by strict economy of space the entire subject could be encompassed within one volume and that for this reason illustrations had to be curtailed too much. When this book goes to a second edition to which it certainly is entitled, it is hoped that the editor, or rather the publishers will see their way clear so to enlarge the volume as to include a number of additional illustrations. But even in its present form, the work is bound to make many friends among students, practitioners, and specialists.

HERE is an intensely interesting and, so far as the reviewer knows, an entirely novel addition to medical literature. Schwalbe, for many years editor of the *Deutsche medizinische Wochenschrift*,[2] has conceived the idea of publishing a series of brief monographs which deal with errors of diagnosis and treatment and their prevention and are meant to be of help to the general practitioner. There are forty-seven of these pamphlets projected, many of which have already been printed. They cover the entire field of medical practice and emanate from prominent representatives of the various specialties.

I have before me five of these slender, paper-bound volumes—three dealing with gynecology, two with obstetrics. Henkel deals with the diseases of the external genitals, the vagina, and the urinary tract and includes in his contribution gonorrhœa, syphilis, and tuberculosis of the female genitalia. Reifferscheid discusses diseases of the uterus, and v. Jaschke writes on diseases of the ovaries, tubes, and the other pelvic structures. Fehling treats of the prevention of diagnostic and therapeutic errors in labor; and Zangemeister views the puerperium from a similar angle. These authors are teachers with wide personal experience and a large consulting practice, and this enables them to recognize the daily needs of the general practitioner and to point out the most frequent diagnostic and therapeutic mistakes made. Because of the purely practical

[1] Obstetrics and Gynaecology. Edited by John S. Fairbairn, M.A., B.M., B.Ch., F.R.C.P.(Lond.), F.R.C.S.(Eng.). London: Henry Frowde and Hodder & Stoughton, 1921.

[2] Diagnostische und therapeutische Irrtuemer und deren Verhuetung. Frauenheilkunde. Edited by Prof. Dr. J. Schwalbe. Leipzig: Georg Thieme, 1921.

purpose of these monographs, all theoretical discussions, bibliographic references, and historical data have been omitted, nor have extremely rare conditions been taken into consideration. These pamphlets, then, are not to take the place of textbooks—in fact, frequent reference is made to the latter so as to induce the reader to consult his standard works for more exhaustive study.

It is not feasible to give any illustrative selections. Moreover, it must be obvious to the reader that this collection is of real value to the general practitioner—and the specialist, too, will find much to interest and instruct him in these pages. An Italian and a Spanish translation are already under way. An English translation would be highly desirable in the interest of those who do not read German. I feel very strongly that the editor may well be congratulated upon his happy idea and the felicitous manner in which it has been worked out.

A TINY booklet[1] giving in minute detail the technique as instituted by DeLee in the Chicago Lying-In Hospital and Dispensary is mentioned here because I imagine that managers of maternity hospitals or outdoor clinics will be glad to adopt this excellent routine and to equip their students, internes, and nurses with this little pamphlet which may be carried in the pocket or satchel. To practitioners who take care of parturient women in their homes, this booklet is warmly to be recommended.

[1] The Technic of the Chicago Lying-In Hospital and Dispensary. By J. B. DeLee, M.D., 1921.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

The Surgical Exposure of the Deep-Seated Blood Vessels. By J. Fiolle, M.D., and J. Delmas, M.D. Translated and edited by Charles Greene Cumston, M.D. London: William Heinemann, Ltd., 1921.

The Surgical Treatment of Non-Malignant Affections of the Stomach. By Charles Greene Cumston, M.D., and Georges Patry, M.D. With an introduction by Sir Berkeley G. A. Moynihan, K.C.M., G.C.B., M.S. London: William Heinemann, Ltd., 1921.

The Medical Department of the United States Army in the World War. Volume xv—Statistics. Part 1—Army Anthropology. Prepared under the direction of M. W. Ireland, Surgeon General of the Army, by Charles B. Davenport and Albert G. Love. Washington: Government Printing Office, 1921.

Abdominal Pain. By Prof. Dr. Norbert Ortner. Authorized translation by William A. Brams, M.D., and Dr. Alfred P. Luger. New York: Rebman Company, 1922.

Proceedings of the Fifteenth Annual Meeting of the Association of Life Insurance Presidents Held in the Hotel Astor, New York, December 8 and 9, 1921.

The Mechanics of the Digestive Tract. By Walter C. Alvarez, M.D. New York: Paul B. Hoeber, 1922.

An Introduction to Dermatology. By Normal Walker, LL.D., M.D., F.R.C.P. 7th ed. New York: William Wood & Co., 1922.

Papers from the Mayo Foundation for Medical Education and Research and the Medical School. Vol. i—1915–1920. Philadelphia and London: W. B. Saunders Company, 1921.

The American Illustrated Medical Dictionary. By W. A. Newman Dorland, A.M., M.D., F.A.C.S. 11th ed., revised and enlarged. Philadelphia and London: W. B. Saunders Company, 1922.

Clinical Electrocardiography. By Frederick A. Willius, B.S., M.D., M.S. (Med.). Philadelphia and London: W. B. Saunders Company, 1922.

Neoplastic Diseases; a Treatise on Tumors. By James Ewing, A.M., M.D., Sc.D. 2d ed., revised and enlarged. Philadelphia and London: W. B. Saunders Company, 1922.

Opiate Addiction; Its Handling and Treatment. By Edward Huntington Williams, M.D. New York: The Macmillan Company, 1922.

CORRESPONDENCE

REMARKS ON BIOGRAPHY OF EPHRAIM McDOWELL BY AUGUST SCHACHNER

To the Editor: In the foreword, the author gives as the motive which prompted this work,[1] the errors and deficiencies characterizing previous biographies of this, the greatest of the pioneer surgeons of America. He states: "Writers have not only copied from one another without investigation, thus perpetuating errors, but in some instances the same writers have contradicted themselves." On page 285 we find the following: "Hence most of the early sketches judged from this viewpoint were not only made prematurely, but seemingly were largely based upon information transmitted from his generation to the next, and apparently accepted without any reservation or special effort at verification." Again, in an address by the author, published in this volume, we find these words (p. 264): "Doctor McDowell has been more than ordinarily neglected, although the Kentucky State Medical Association did erect in the year 1879 a monument at Danville to his memory." Throughout the entire volume this conception as to the imperfection and inadequacy of all preceding efforts to perpetuate McDowell's memory and achievements seems to dominate the author's mind, and supply the need for a more complete exposition of the subject. As a matter of fact, none of the great pathfinders in American Medicine and Surgery has elicited more careful study and received such distinguished honor from the succeeding generation as has "the Father of Ovariotomy."

Doctor McDowell died in 1830. In 1852 Dr. Samuel D. Gross, then a resident of Louisville, read his biography of Ephraim McDowell, afterward incorporated in Gross' American Medical Biography, to the Kentucky State Medical Society. With rare discrimination and persistent energy, Professor Gross sought out by correspondence and personal interview the associates, relatives, and former patients of McDowell, gathered together the published reports of his operations, and wrote a biography which is a model of accuracy and appreciation. As to the essential facts relating to McDowell's life-work, his character and his surgical ideals, little has been added to, or subtracted from, Gross' original paper.

In 1873 Dr. John Davies Jackson, of Danville, Kentucky, a physician of exceptional literary and scientific attainments, published a biographical sketch of McDowell. Referring to Gross' biography, he says: "He (Doctor Gross) has gone over the field, as we have found out, with extraordinary labor and care, and his conclusions and comments upon the character of the subject of his sketch, as we have verified them through the remaining contemporaries of McDowell, are most just and discriminating."

In 1879 the dedication of the monument erected at Danville to the memory of McDowell by the Kentucky State Medical Society was the most imposing and impressive occasion in the annals of the medical profession of Kentucky. The dedicatory address was delivered by Professor Gross before a large audience, composed of members of the society, distinguished physicians and surgeons from distant states, officials of the state and citizens of Danville and vicinity. The classic address of Professor Gross, together with other addresses and letters incident to the occasion, were published in a handsome volume, bearing within a steel engraving of McDowell, and widely distributed. The international reputation of Professor Gross did much to carry his message throughout the world.

In 1909, when a century had elapsed since McDowell's first ovariotomy, the American Gynecological Society held a meeting in his honor. This centennial celebration took place in New York City, thus making the event distinctly national in character. Papers were presented by Fellows of the Society upon McDowell's original surgical work and its growth in America. Herbert R. Spencer, of London, read a paper on the "Evolution of Ovariotomy in Great Britain"; Professor Pozzi, of Paris, gave the history of the operation in France, and Professor Hoffmeier, of Wurzburg, treated the subject in relation to Germany. Each of these distinguished foreign surgeons presented his paper in person. The volume of transactions containing these papers and other proceedings honoring McDowell's memory is marked by distinctive binding bearing the title "McDowell Centennial."

Space will not permit an enumeration of the other proceedings and publications at home and abroad which honor the name of Ephraim McDowell. Upon the pages of every modern treatise on surgery and gynecology, and throughout medical literature, his name will be found.

It is apparent that the author of the book under review has made a diligent study of the literature relating to McDowell, and from many of the publica-

[1] Ephraim McDowell, "Father of Ovariotomy" and Founder of Abdominal Surgery. By August Schachner, M.D. Philadelphia: J. B. Lippincott Co., 1921.

tions enumerated he quotes; yet he seems at times to detach himself from recognized facts to indulge in such extreme statements as "Doctor McDowell has been more than ordinarily neglected, etc."

On page 222 the author in alluding to the removal of the remains of McDowell and his wife from the family burying-ground to McDowell Park in Danville makes an erroneous statement, which does injustice to the committee which performed this duty for the venerated dead. He states that he was informed "that the McDowell grave remained open following the re-interment, as those in charge were unable to decide whether the remains of Mrs. McDowell should be removed with those of her husband. Strange to say, this remained an open question for some years, until it was finally referred to Dr. J. M. Toner, of Washington, who settled it by directing that the remains of Mrs. McDowell be placed by the side of her distinguished husband, where they naturally belonged."

The writer of this review as chairman of the McDowell monument committee personally employed the undertaker who made the removal and superintended the same. Both bodies were exhumed on one and the same day, carried in the same conveyance, and re-interred, side by side, at the base of the monument in McDowell Park. In a work so elaborate in details as the book under review, such a statement based upon rumor should not have been recorded when the facts could easily have been obtained from official sources.

It is to be hoped that other biographies of McDowell will be written. Indeed, it would be well if the American College of Surgeons would establish a lectureship in his honor, similar to the Hunterian Oration in England, in order to keep before the profession his high scientific ideals, the example of his courage and self-reliance, and his exalted conception of his duty to humanity. To do this, however, it is not necessary to discredit the work of those who rescued his name and fame from oblivion, placed a monument over his grave, and won for him the grateful recognition of surgeons throughout the civilized world.

Lewis S. McMurtry.

Louisville, Kentucky.

AN ORIGINAL OPERATION UPON A DOUBLE UTERUS

To the Editor: After a careful review of the literature, I find so little written upon the subject of double uterus that I am led to believe my experience to be unusual. I have seen 2 cases of pregnancy in double uterus and one pregnancy in a single uterus with a double vagina, besides a considerable number having the same deformity without pregnancy.

The first case of pregnancy in a double uterus was encountered when giving relief to a case of incomplete abortion. This case, after recovery, disappeared from my view. The only suggestive factor was that this woman was an habitual aborter, this having been the fifth spontaneous abortion.

The pregnancy with double vagina was without interest, except that the partition divided the vagina into two large cavities, one not communicating with the cervical canal. After excision of partition the baby was born without difficulty.

The subject of this paper has to do with the second case of pregnancy in a double uterus, the history being as follows:

Mrs. Kate M. of Middlebury, Pennsylvania, was admitted to the Williamsport Hospital as a private case on July 2, 1914, accompanied by her family physician, Dr. C. W. Sheldon, of Tioga, Pennsylvania.

Examination disclosed a young woman of twenty-five, married 2 years, no pregnancies, menses normal, morning nausea, mammary enlargement, who while bathing had discovered a lump in the lower abdomen. We made an investigation, and thought the condition a pregnancy with a tumor of fair size, anterior to internal os. The patient lived about one hundred miles from the hospital, therefore all discussion as to variety of tumor was purely academic. It might be a dermoid, but it mattered not to the patient. She was frightened and desired an operation to safeguard her future.

July 4, 1914, a laparotomy was made disclosing a double uterus with pregnancy in one barrel. The left pregnant side was greatly distended, with a 3 months' pregnancy; the uterus had enlarged laterally, and the wall was so thin that the fœtus could easily be felt and shadow seen. It seemed clear that if the pregnancy were left, rupture would surely occur; therefore we did a hysterotomy and removed fœtus and placenta.

Examination of interior of uterus disclosed a firm, thick walled septum, extending from fundus to cervix, and it seemed that the uterine compartments must have been of nearly equal size prior to pregnancy. I massaged the uterus and involution proceeded rapidly. At this point it occurred to me that it might be possible to make one uterine cavity by removal of septum, as we did in operating upon double vagina. I, therefore, carefully excised the septum, after splitting the uterus to a point well below internal os, but not to end of cervix. Upon anterior surface of uterus, we excised all that portion of uterus occupied by partition, and upon the floor of uterus carefully excised a V-shaped segment, containing partition base well into muscularis. One layer of No. 1 gut closed end of endometrium over V-shaped incision in floor of uterus, and by biting well into muscularis controlled bleeding and reinforced cut muscle fibers. The anterior wall was closed in the usual manner following hysterotomy, care being taken to control bleeding and approximate peritoneum.

The only feature of the operation which I thought difficult was the removal of the septum in such a manner as to prevent its recurrence, for my experience with double vagina had taught me these partitions will reform if merely torn through. Consequently, the suture of the floor of the uterus was carefully and gently done.

The patient made an uneventful recovery, and passed from my notice until July 2, 1921, 7 years

later, when I received a reply to my note of follow-up, as follows:

"Your letter received and am glad to tell you that I have had fine health since my operation in 1914.

"Have had two babies since that time, one born in November, 1915, and one in March, 1918. Didn't have any trouble at either time, and both are strong healthy girls. Am still having good health at this time."

You will note from Mrs. M's letter she has had two babies; the first one born 16 months after operation, and one 3 years later, which, of course, proves that our attempt at conservatism met with success, and that the present-day teaching of hysterectomy in these cases is not justifiable and not in accord with modern conservatism.

H. J. Donaldson, M.D., F.A.C.S.
Williamsport, Pennsylvania.

A CURED CASE OF INFILTRATING OSTEOGENIC BONE SARCOMA

THIS case is reported for the sole reason that it is the longest case on record of a cure of the above disease that has met the requirements in the way of proof laid down in the effort to get at the true results in this disease by Drs. Codman, Bloodgood, and Ewing. The case has remained well since amputation of the leg on August 5, 1909.

W. B. entered the Hartford Hospital, history number 48,703, in May, 1909, with a history that his trouble had begun with a trifling injury in the preceding February. This injury was called a "strain." The patient also thought that this portion of the leg (lower part of femur) habitually rested against the steering post of his automobile. The patient looked run down and thin, but as he gave a history of furunculosis, I was under the impression that he probably had either a periosteitis or an epiphysitis. On May 22, I made an exploratory incision, and found a soft bony tumor. The bone was readily broken up into the depths of the epiphysis and the joint was avoided with some difficulty. Sections of tissue taken at this operation were reported to me as osteomyelitis. Study of these sections at a later time showed a little piece of undoubted sarcoma on one edge of the slide, which had been overlooked by the pathologist. Confused by this first report, I had to revise my clinical diagnosis of sarcoma, and treat the condition as an inflammation.

The young man continued to lose weight and color and a pulsating tumor soon filled the wound. X-ray pictures on July 17 gave the appearance of a circumscribed sarcoma, but I could not say positively that it was not an osteomyelitis. These X-ray pictures have unfortunately been mislaid and cannot now be found. The patient's leucocytes were 8,000 and there was no fever. The von Pirquet test at this time was positive, but there was no response to the subcutaneous injection of 1, 3, or 6 milligrams of tuberculin. The patient gave no clinical history of, and has never at any time taken any treatment for, syphilis.

On July 24, I cut the hamstring tendons, straightened the leg, and at the same time did a very extensive total excision of the tumor, which, as I made a note at the time, I believed was a sarcoma. Sections from this operation were reported definitely as a "large round cell sarcoma." The diagnosis was thus corrected. On August 5, 1909, I amputated the leg just above the middle of the thigh. The bone at the point of amputation seemed normal. The stump was closed with a posterior flap. The patient made an uneventful recovery and was discharged from the hospital August 27. He was able to go to work as a chauffeur September 24, and a month later had gained 26 pounds. He is now living and well and is a farmer by occupation.

In response to Dr. Codman's invitation issued to surgeons generally throughout the United States, I sent sections from this case to him and they have been carefully studied both by himself and by Drs. Bloodgood and Ewing.

Dr. Ewing writes: "I was much impressed by your case of bone sarcoma. It appears to be a genuine cure of osteogenic sarcoma by operation. They are certainly very rare."

Dr. Bloodgood writes: "Apparently there is no question that this is a sarcoma."

Dr. Codman writes: March 7, 1921. "After all is said and done your case stands unequalled as the only living cured case of osteogenic sarcoma we know of."

Since then they have verified three other cases, which they have recently reported. (Surgery, Gynecology and Obstetrics, March, 1922.)

Other pathologists perhaps might differ with these gentlemen but by their plan of a registry, such sections will be preserved permanently for restudy by anyone interested. Future students are likely to reclassify these tumors of bone, but for the present this case must stand as an instance of amputation saving life, in spite of two primary exploratory operations.

It would appear that the method offered by these three doctors of certifying surgical diagnoses and results, might well be applied to other conditions. If certain standards were demanded for a certified diagnosis of the more rare conditions in surgery and other standard requirements were maintained in respect to the results of operation, surgical literature could be immensely reduced in volume and increased in value. It is sincerely to be hoped that the American College of Surgeons will be able gradually to assume the function of certification in many conditions along some such line as Dr. Codman has initiated in the case of bone sarcoma.

Ernest A. Wells, M.D.
Hartford, Connecticut.

AMERICAN COLLEGE OF SURGEONS

MARCH AND APRIL MEETINGS OF STATE SECTIONS OF THE CLINICAL CONGRESS OF THE AMERICAN COLLEGE OF SURGEONS

DURING March and April there were three meetings of state sections of the American College of Surgeons, in Birmingham, Alabama; Asheville, North Carolina; and Allentown, Pennsylvania.

BIRMINGHAM, ALABAMA

The meeting in Birmingham took place March 2 and 3, with headquarters at the Tutwiler Hotel. Dr. Cunningham Wilson, Birmingham, presided.

The states of Louisiana, Mississippi, Alabama, Georgia, and Florida were represented in this group. It would seem evident that the grouping of five states on such an occasion is inadvisable, not only on account of the amount of travel involved for attending Fellows, but because of the somewhat evident lack of complete co-operation arising from the attempt to spread the meeting-interest over five states. Representation from at least two of the states should have been better than it was, and doubtless would have been in a meeting of as small a group as three states.

Ninety-seven Fellows were in attendance.

In addition to the members of the central office, Dr. J. M. T. Finney, Baltimore; Dr. William R. Cubbins, Chicago; and Dr. E. P. Hogan, Birmingham, addressed the hospital conference and the public meeting.

The clinics, as has been found to be the case throughout the South, were well organized and well carried out, with a very encouraging attendance of Fellows.

The hospital conference was attended by about 150.

The public meeting had an attendance of about 300, which number would have been largely increased had the size of the hall permitted it. The addresses of Dr. Finney and Dr. Cubbins were of special interest here to the laity as well as to the attending surgeons and Fellows.

The scientific session was attended by somewhat over 100 and developed quite effective discussions of the papers presented.

ASHEVILLE, NORTH CAROLINA

An interim of two weeks intervened between the meeting of Birmingham and that of Asheville, North Carolina, during which period Mr. Raymond of the central office visited the Fellows of South and North Carolina.

The Asheville meeting, under the executive chairmanship of Dr. Jacob F. Highsmith and under the management of Dr. H. H. Briggs, chairman of the committee on arrangements, proved a high point in the tour of the country. The smaller sessions were held in the Convention Hall of the Battery Park Hotel; the public meeting at the Asheville Auditorium.

There were 117 Fellows in attendance at the group meeting.

Visiting speakers were Dr. John B. Deaver of Philadelphia, president of the College; Dr. John O. Polak, Brooklyn; and Dr. Joseph C. Bloodgood, of Baltimore.

The hospital conference presented the first tryout of the round table discussion in state meetings, in this case led by Superintendent Robert Jolly of Houston. The meeting, being intended to discuss problems and to present assistance to the hospital people as well as to instruct them, succeeded rather effectively through the round table in accomplishing an end. It would appear desirable to establish this as a uniform part of the program for future hospital conferences.

The public meeting Monday night entirely filled the main floor of the Asheville Auditorium. The addresses of Dr. Bloodgood on "Preparedness against Cancer," and of Dr. Polak concerning "Antenatal Care" were of natural and large interest to the audience.

A departure from the usual routine was had in the arrangement of the scientific sessions which occupied the entire second day of the convention, replacing the usual forenoon clinics. The representation of both North and South Carolina on the program was effected, and the papers, many of them illustrated, were presented with unusual care and detail.

The afternoon scientific session was one of especially marked interest owing to the clinic presided over by Dr. Deaver, and participated in by Drs. Bloodgood and Polak, as well as by attending Fellows, speaking from the floor. These cases had been prepared by the Fellows of North Carolina, and the completeness of the diagnostic work and notes made possible a detailed discussion by the speakers in each case.

ALLENTOWN, PENNSYLVANIA

The Fellows of Pennsylvania, Delaware, and New Jersey met in Allentown on April 3 and 4.

Dr. William L. Estes, of Bethlehem, presided, and Dr. C. D. Schaeffer, of Allentown, chairman of the committee on arrangements, carried out one of the most successful meetings that the College has had in this quarter of the year.

The hospital conference was opened by Mayor Gross, of Allentown. In addition to the speakers of the central office, Dr. Polak, Dr. Schaeffer, Dr. Baldy, and Dr. Housman were on the program. This conference reached the high-water mark of all such meetings so far held, there being fully 400 in attendance.

The public meeting at the Allentown High School Auditorium likewise was one of the largest public meetings that has yet been held, over 1300 being present. Of the visiting speakers, Dr. Deaver spoke on "Public Recognition of Scientific Medicine" and Dr. Polak on "Prenatal Care." The co-operation of churches and schools was indicated by the presence on the program of Monsignor Peter Masson, rector of the Church of the Sacred Heart, and the Rev. William F. Curtis, president of Cedar Crest College.

The scientific session was likewise larger than any previously held during the Spring, over 300 being in attendance. Admiral Stitt, surgeon-general of the U. S. Navy, and Professor M. J. Rosenau of Harvard Medical School, addressed the meeting.

Tuesday evening, the Fellows were guests of the Allentown Chamber of Commerce, where 160 members of this body listened to the College program for the betterment of surgery, hospitals, and public health.

COMING MEETINGS

New England States at Portland, Maine, May 15–16.

Nova Scotia, New Brunswick, and Prince Edward Island at Halifax, Nova Scotia, May 19–20.

Fig. 4a.

Fig. 4a.

Fig. 4c.

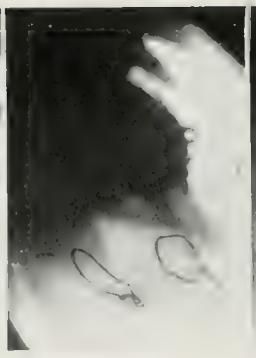

Fig. 4c.

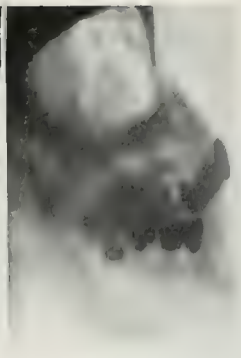

Fig. 4c

Fig. 4b.

Fig. 4b.

Fig. 4b.

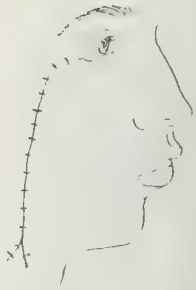

Fig. 4b.

Fig. 4d.

Fig. 4d.

Fig. 4d.

Fig. 4d.

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

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RECONSTRUCTION SURGERY OF THE FACE[1, 2]

BY V. P. BLAIR, M.D., F.A.C.S., ST. LOUIS

IT is not generally recognized that, on the average, larger facial defects are created in the treatment of cancer than by battle casualties. These and punitive mutilations, have made plastic surgery of the face one of the earliest types recorded. Long before the war, its possibilities were beginning to take on concrete expression, but to date the encomiums that have been showered upon it are at least partially dependent upon comparison for their justification.

The most important part of any surgical procedure is a plan, and the more closely and intimately this plan fits the needs of the case, the better will be the result. In reconstruction of the face, the plan should be as accurate and comprehensive as those used by the occulist, the dentist, or the journeyman tailor. In the creation of the plan, we should mimic the methods of the sculptor or the tailor who materializes his conceptions in clay or paper before attacking the marble or cloth. If reconstruction surgery of the face should continue to develop along the lines upon which it is well started, I can see no reason why, in the majority of cases, given a healthy patient and a really good surgeon (who must have the feeling of an artist, the skill of an ordinary tailor, and the tenacity of a rat-terrier), there should not be produced in flesh and bone features that compare favorably with those created by the accepted sculptor or painter; but it will require skill and training and no end of hard work. Until such men are trained to work in this line, the results must continue to be archaic and not incomparable to those that would follow if each man here were from now on forced to make his own clothes. Some would do better than others and certain individuals would attain to comparative skill but it is probable that there would not be one first-class tailor in the entire number.

Satisfaction with one's appearance has a tremendous bearing on poise and self-confidence. Disregarding battle casualties, skill in the correction of facial defects will open up a very substantial field of legitimate and much needed surgery.

In the making of the plan, the most important single thing to be regarded is that the value of facial balance far outweighs that of any individual feature. When preserved or restored, it has saved many a result that had little else to recommend it and when lacking will seriously mar the best technical efforts.

Mars feels that he has done enough for surgery when he furnishes the victims and has always frowned upon the interruptions incidental to treatment, but in spite of this, through the kindly analysis given by our late friend, General Gorgas, and the characteristic "Go to it," which was the response

[2] Being a record of the treatment of certain battle casualties, in the United States Army General Hospital No. 11 and at the Post Hospital at Jefferson Barracks, in association with Major Frank Tainter, M.C., Captain George Cross, M.C., Captain Lee Cohen, M.C., Captain N. H. Horni, M.C., Captain J. H. Dyer, M.C., Captain F. J. Moeninghoff, M.C., Captain E. J. Dameron, D.C., Lieutenant D. H. McCauley, D.C., Lieutenant B. H. Worthley, D.C.

[1] Presented before the Clinical Congress of American College of Surgeons, Philadelphia, October 20, 1921.

Fig. 1a.

of General Ireland to any worth-while proposition that seemed feasible, the planning of facial operations received a tremendous impetus in this country by the use of the artists, sculptors, and photographers which the army furnished to co-operate with the surgeon in all stations especially designed for this work.

I want to take advantage of the opportunity you have given me this evening to present a few types of facial cases that have been treated in the army, and do this both as a tribute to the consideration this work received from the medical and dental departments at large, and also to record possibly a comparatively early stage in the future development of this work.

Figures 1a and 1b show scarring from shell wound that destroyed parts of cheek, chin, lower lip, and a section of the lower jaw. In the repair of the soft parts the chief scars in the cheek were excised and tissues undermined until the skin could be smoothly sutured without a depression. A flap was cut from the cheek adjacent to the lip and nose. The part of the flap above the dotted line included skin and some subcutaneous tissue, below the dotted line the full thickness, including the mucosa, was taken with the flap. An incision was made along the mucocutaneous junction, bordering the defect and the mucosa dissected up so as to permit the implantation of the flap.

Figures 2a and 2b. Simple excision of a broad scar and repair of the defect. Where the scar is irregular in shape it is desirable so to plan the excision that the least possible amount of good skin will be sacrificed. These pictures illustrate such a procedure. Before attempting to draw together the borders of the wound, the surrounding tissues are undermined as far as the dotted line so that they can be approximated without tension. In this situation the undermining is made just superficial to the periosteum.

Figures 3a, 3b, and 3c. 3a, Shows the result of a deep oblique cut made by a shell that destroyed the eye and lower eyelid and allowed the cheek and corner of the mouth to slump down. The injury did not involve the bone. 3b, Shows the plan of repair. At the first operation the scar area was excised (indicated by oblique shading) and the tissues undermined to the extent indicated by the dotted line. Above and external to the excised scar the plane of undermining was made superficial to the buccal and temporal fasciæ, while below and in front of it the soft tissues were raised from the bone. The lower flap was made to overlap the exposed buccal and temporal fasciæ and sutured in place. This filled the defect and raised up the cheek and corner of the mouth. At a subsequent operation Captain George Cross, M. C., U. S. A., after separating the mucosa from the skin surrounding the lower eyelid defect switched in a temporal flap to replace this eyelid. 3c, Shows the result of the first operation. The line of dots across the cheek show spots of pressure atrophy due to the buttons holding deep tension sutures. 3d, Eyelid in place. This is a photograph of the patient after completion of his case.

Figures 4a, 4b, 4c, 4d. 4a. A shell wound through the full thickness of the cheek and body of the mandible which has partially healed with the cheek tissues slumped downward. A relatively small, sharp-edged

Fig. 1b.

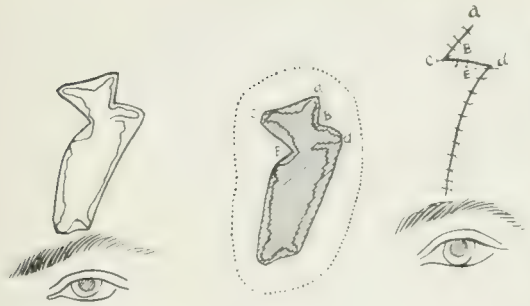

Fig. 2a.

piece of shell spinning around like a circular saw could cut a very deep and wide gash in the tissues.

Figure 4b. Diagram illustrating scheme of correction. The first figure in the drawing represents the condition on return from overseas. The shading in the second figure shows the plan of scar excision which went completely through the cheek into the mouth. The dotted line shows the extent of the deep undermining which was just superficial to the bone, while there was a less extensive plane of undermining done bewteen the skin and the muscle. Note the conservative manner in which the scar excision was done and how the external canthus as well as the whole cheek was raised by the suturing. In suturing, the buccal mucosa was approximated with tannated gut and the intermediate tissues were overlapped with plane gut for the double purpose of elevating the cheek and corner of the mouth and of filling out the thickness of the cheek. This latter line of sutures was reinforced by deep mattress, silkworm-gut stay sutures which were tied over rubber tubing or buttons on each side of the wound. Skin was closed with interrupted horsehair. The depth of the wound was freely drained with rubber dam strips both on the buccal and external surfaces. This latter step is important. Such wounds are always soiled and have irregular spaces in their depths that cannot be immediatly obliterated to advantage. It is my observation that the blood clot can play only a sinister rôle in plastic surgery. The third figure in the drawing shows the preliminary ligation of the external carotid artery as a means of limiting hæmorrhage. A temporary control of the opposite common or external carotid is usually of further advantage. In the Casualty Clearing Station it was a notable fact that wounded soldiers bled very little at the first operation and even with large *débridements* few ligatures were necessary. At later operations, however, the conditions are reversed, and the hæmorrhage from excision of scars becomes so excessive as often to threaten life, if very careful preventive measures are not employed. The mere use of hæmostatic forceps is not sufficient, for in many of these cases, forceps cannot be placed sufficiently close together to control all the bleeding points. The fourth figure in Figure 4b shows the wound sutured.

Fig. 2b.

Figure 4c. The roentgenogram to the left shows the defect in the body of the lower jaw corresponding to the cheek cut. Note that the ramus is drawn forward, which has lessened the apparant extent of the defect. The sliding pedicle graft was taken from the lower border of the mandible and fastened in place with wires which were left protruding through the surface wound to provide drainage. A supplementary drain was placed in the most dependent part of the wound, not in contact with the bone. The mouth was accidentally opened during the procedure. This is a routine precaution against the blood clot which some operators court. The roentgenogram to the right shows the bone graft grown solid. During the healing process, both jaws were fixed by a splint made by Captain Dameron, D.C., U. S. A.

Figure 4d. Profile and full front views of the case showing condition at the time of operation and at discharge from the hospital. Note that the external canthus, the corner of the mouth, and the cheek have all been elevated.

Figures 5a, 5b, 5c, 5d, 5e, and 5f. Figure 5a. Drawing of case in which most of the injury was confined to the inside of the mouth, destroying the lining of the right cheek, a section of the body of the mandible and some of the full thickness of the cheek near the angle of the mouth. The malar bone was fractured and pushed outward which resulted in cheek bone and zygoma being more prominent. The first step in the operative treatment was to restore the lining of the cheek and also the skin about the corner of the mouth. This was done by removing all of the scar and then cutting a long flap from the neck and chest which was drawn into the mouth through an incision in the lower buccal fornix, and the tip of the flap was drawn out through the oral fissure and sutured into the external cheek defect, as shown in the central drawing. Twelve days later the pedicle was cut and the base of the flap returned to the neck. The figure to the right shows the amount of the flap that was left in the cheek.

Fig. 3a. Fig. 3c. Fig. 3d.

Fig. 3b.

Figure 5b. The photograph to the left shows the condition immediately after the long flap was sutured in place. The defect resulting from removing ing the flap from the neck and chest has been obliterated by undermining and drawing the edges together. The lower end of this sutured wound, the depth of each pocket in the neck resulting from the undermining, and the potential pocket resulting from the twist made where the flap turns on itself to enter the mouth and the space between the flap and the cheek are all drained by rubber dam drains which have been sutured in place. The latter two of these drains are of particular importance in cases in which the parotid gland is still active. In many it seems to have been destroyed by obstruction of the parotid duct by scar. The photograph to the right shows a later condition when the flap has healed in place and is forming the lining to the cheek. Skin so turned into the mouth usually behaves very well, becoming pink in color and rather closely resembling mucous membrane. Occasionally, when redundant, it rises into folds formed by the scar base and requires partial excision. If it is hair-bearing, the hair will continue to grow and will require trimming until it is destroyed by radium.

Figure 5c. The roentgenogram shows the repair of the bone defect which was closed partly by a sliding bone graft made from the lower end of the ramus and partly by an outgrowth of new bone which was formed as the two ends of the bone were slowly separated by a traction splint. This gradual separation of the ends restored the jaw to its normal occlusion, the potential gap being filled with new bone which formed concurrently with the separation of the fragments. The roentgenogram also shows the gap in the ramus where the subcutaneous saw cut was made and shows the bar of new bone that helps to bridge the gap.

Figure 5d. The photograph to the left shows the soft parts repaired but abnormal width of the right side in the malar region still persists. To determine the exact amount of this increase, a plaster cast was made of each side of the face, and the left cast was built up with clay until it was of the same prominence as the right. The piece of built on clay was then cut through to determine its depth. This piece showed the amount

Fig. 5a.

that had to be removed from right cheek bone to make it correspond to the left; the normal side.

Figure 5e. The photograph to the left shows distortion of cheek and mouth, original condition.

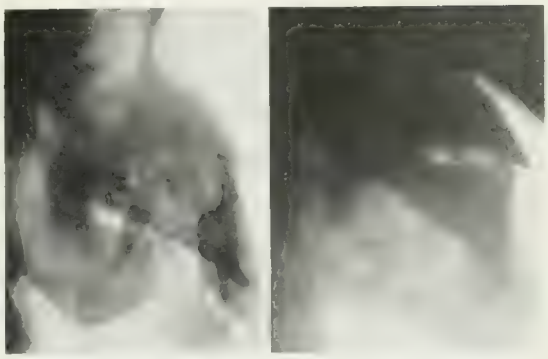

Fig. 5c.

Fig. 5b.

Fig. 5b.

Fig. 5d.

Fig. 5d.

Fig. 5e.

Fig. 5e.

Fig. 5f.

Fig. 5f.

The patient at that time had the posterior part of the body of the right mandible drawn forcefully against the palate. The photograph on the right shows the condition when the patient was discharged from the army. The jaw bone is solid and he can open his mouth freely.

Figure 5f shows the lateral aspect taken at times corresponding to Figures 5e.

Figures 6a and 6b. Illustrates a case in which a large opening in the anterior part of the palate, caused by piece of shell, was repaired from a skin-covered pedicle flap taken from the front of the

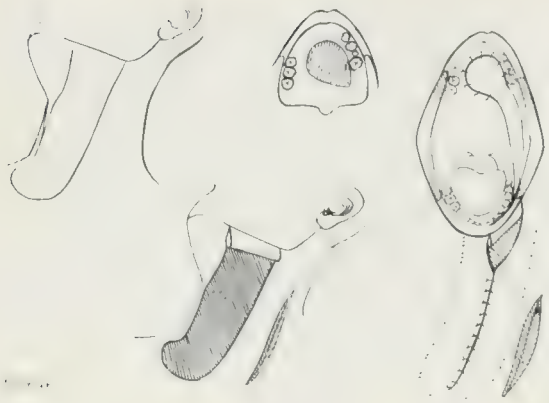

Fig. 6a.

chest. The upper left hand figure shows schematically the flap outlined; the upper central figure, the opening in the palate; the lower central figure, the flap turned into the mouth through an opening in the inferior buccal fornix with a relaxation incision posterior to the defect in the neck. The figure to the right shows the flap sutured into the palate defect and the neck defect closed by drawing its borders together. The next step would be to cut the pedicle of the palate flap at the palate border, freshen its granulating surface, and, after reopening the upper part of the healed neck wound, suture the pedicle back into the neck. This is shown in Figure 6a. The relaxation incision will close of itself. Later these rather rough scars can be excised and more exact approximation made by careful suture. Even the scars can be further improved by the use of radium, but a vertical scar in the neck will always be visible.

Figure 6b shows photographs of the condition in various stages. In the one to the right, as yet no attempt has been made to improve the neck scar, and the flattening of the upper lip is due to lack of teeth, later corrected by a denture. In the middle photograph the patch in the palate forms a rather prominent pad which later, with the use of a dental plate, flattened to conform to the general contour of the palate.

Figures 7a and 7b. Figure 7a. Diagramatic illustration of the correction after the lower lip and most of the covering of the chin had been torn away by a piece of shell. Scar contraction had drawn the neck tissue up over the mandible until much of the original defect had become covered, as shown in the right upper illustration. The excision of the scar left the defect shown in the left upper figure. From the lower point of the "V," on each side an incision was made to the bone downward and outward to the lower border of the mandible and then back to the anterior border of the masseter muscles, the flaps being dissected entirely free from the periosteum. A corresponding incision was made through the mucosa along the inferior buccal fornix. At the posterior extremity, this horizontal incision in the mucosa turned sharply upward to end just beneath the opening of the parotid duct. This vertical part of the intra-oral incision went through, not only the mucosa, but the buccinator muscle and buccal fascia. The anterior part of each of the two cheek flaps thus mobilized was rotated upward until the edges that formed the lateral borders of the "V," were made to form the free border of the lower lip. By the incision described and some undermining in the submucous tissue, the buccal mucosa had been sufficiently freed to permit of its being drawn over the raw surface on the border of the new lip and sutured to the skin, thus making a vermillion border. Suturing these flaps to the tissue on the point of the chin that had become fixed there by scar, in turn fixed these flaps in their new position. Originally there had been some loss of tissue in the left cheek below and external to the corner of the mouth. Including this last mentioned scar in the excision, made the left arm of the "V," longer than the right which accounts for the fact that more of the lower lip was fromed from the left flap than the right. With this, however, there was a corresponding deficiency in the vertical extent of the left half of the lip near the corner (central Figure 7b), which was compensated for by the flap "A" taken from the junction of the cheek with the upper lip. The lower left figure shows

Fig. 6b. Fig. 6b. Fig. 6b.

the flaps sutured in place. The artist has used some poetic license in portraying the outline of the vermillion border. The lower right figure is a good representation of the lateral aspect of the case when finished.

Figure 7b. The left photograph shows condition when the case reached reconstruction hospital in this country. Central figure shows condition after large cheek flaps were brought into place but before the small upper "A" flap was turned down. Right figure shows the completed case.

Figures 8a, 8b, 8c, 8d, 8e, 8f, 8g, 8h. Figure 8a. The right hand figure is a diagramatic reproduction of a roentgenogram of a case in which a shell passed through both cheeks, splintering the body of the mandible on both sides and tearing a large hole of exit on the right side. Owing to the press of war conditions, neither proper fixation nor drainage was established at time of injury, and this, added to lack of special care in subsequent evacuations, permitted of extensive necrosis of the bone and loss of all teeth in the remaining chin fragment. When he arrived at a reconstruction hospital 10 months after injury, there was a loss of the body of the mandible from the second molar to the cuspid tooth on the left side, and the lower half of the ramus and the body so far forward as the cuspid tooth on the right. There was union on neither side and no teeth in the chin fragment. The teeth in the upper jaw were good. Captain Daniel McCauley, D.C., U. S. A., and Lieutenant B. W. Worthley, D.C., U. S. A. constructed an aluminum splint to embrace all of the upper teeth and palate, having a protruding bar which extended forward to a distance of 3 inches in front of the incisor teeth. On the left side, the ramus was subcutaneously cut in two transversely by a wire saw, and the ends of the body bordering the defect on that side were freshened and wired together, after the newly constructed jaw was pried and dragged forward. Two heavy wires were pressed around the mental fragment and fastened to the end of the bar on the splint, or rather to a downward extension of this bar which brought the line of traction into the plane of the body of the mandible. The figure also shows: (1), the cut in the ramus;

Fig. 7a.

(2), the posterior body fragment including the angle dragged forward; (3), the wire uniting the two fragments with its twisted ends protruding for drainage; (4), the two circumferencial traction wires passing about the mental fragment. The photograph at the left shows an external view of the splint and wires and the scar due to loss of tissue on the right side of the face. The strain on the splint was so great that it caused pain and threatened the anchorage of the upper teeth. To relieve this the patient was put to bed and a counter weight was applied to a cord which was attached to the bar of the splint and passed over a pulley block in the ceiling, as shown in Figure 8b. After a week or 10 days this weight

Fig. 7b. Fig. 7b. Fig. 7b.

Fig. 8a.

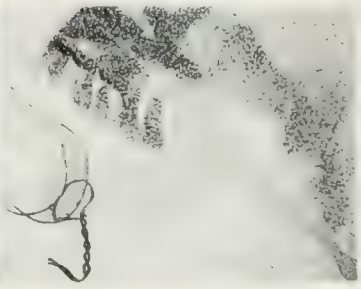

Fig. 8a.

Fig. 8e.

Fig. 8e.

Fig. 8b.

Fig. 8f.

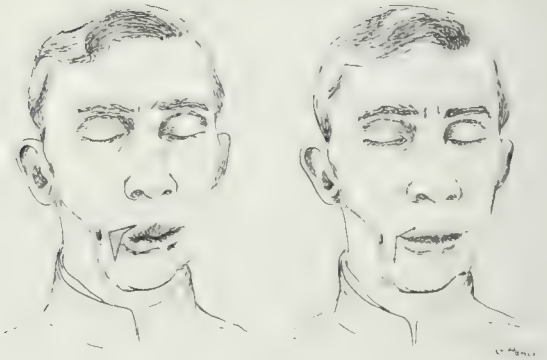

Fig. 8d.

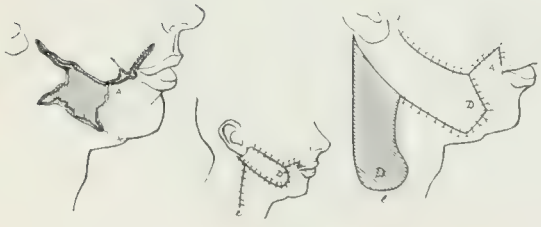

Fig. 8c.

extension was dispensed with. The next operative step was excision of the scar and the transfer of a flap from the side of the neck to the cheek, as shown in Figure 8c. An attempt was made to plant a piece of rib into the site from which this flap was to be obtained, but owing, probably, to an injury of

Fig. 8g. Fig. 8g. Fig. 8h. Fig. 8h.

the parotid gland, there was necrosis of tissue and the rib had to be removed and transfer of the flap delayed.

Figure 8d shows a plastic operation that was done to correct the sphincter-like appearance of the right corner of the mouth. The shaded area in the left hand figure was excised through the full thickness of the cheek, and the wound closed, as shown in the right hand figure. Figure 8e shows the results obtained by the operations thus far described.

Following the plastic on the right cheek, a Gillies bone-cartilage graft was placed in the defect in the right side of the mandible. One-half inch of the tip of the left ninth rib and almost all of the cartilage, which makes a sharp angle, was removed and the rib part was united to the freshened left end of the mental fragment while the sternal end of the cartilage was buried in a tunnel burrowed between the soft tissues and the external surface of the remaining part of the ramus. This operation had to be performed in two steps. After preparing the bed to receive the graft, to avoid using the great number of ligatures that would be needed partially to control the bleeding, the wound was closed with 24-hour drainage and about a week later it was re-opened and the graft inserted.

Figure 8f. The figure to the left shows the cartilage-bone graft replacing the right body of the mandible. The cartilage is visible in the roentgenogram because of lime deposits. When first seen it was thought that this might be due to the change of function, but an X-ray of the chest showed all cartilages similarly affected. Comparing the right figure of 8f, with the right figure of 8a, there seems at first glance, to have been an apparent lengthening of the reconstructed body. Careful comparison leads to the conclusion that this is an actual lengthening due to the ramus, which was dragged forward at the time of operation, gradually retreating to its normal position with a concurrent deposit of bone at the site of union, the mental fragment being fixed at the time by the splint. The roentgenogram shows that the mental fragment has not materially changed its position. Such a deposit of bone at the site of a mandibular fracture, when the fragments are gradually drawn apart by a traction splint, has frequently been observed and quite large gaps have been made to fill in by this procedure.

Figure 8g. Front views of this patient which were taken to show the condition of the patient at the time of entering the reconstruction hospital and at the present time.

Fig. 9a. Fig. 9a. Fig. 9b. Fig. 9b.

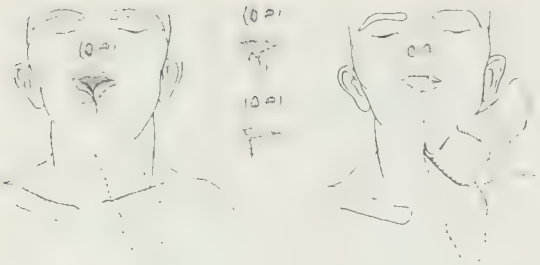

Fig. 9c.

from the serious objections that have been raised against infiltration of tissues with the melted wax.

Figures 9a, 9b, 9c, 9d, 9e, 9f, 9g. Figure 9a. Photograph to the right shows a man in whom the right two-thirds of the upper lip, the lower half of the right cheek, the greater part of the lower lip and chin, and all of the mandible in front of the second molar teeth were destroyed by a shell fragment. The first step in the reconstruction was to cut the ramus in two, transversely on each side, and slide the remaining part of the body and angle of each side as far forward as possible where they

Fig. 9d. Fig. 9d.

Fig. 9e. Fig. 9e.

Fig. 9f. Fig. 9f.

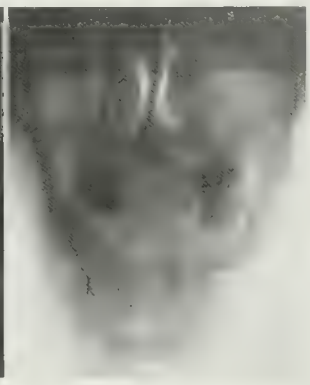

Fig. 9g.

Figure 8h. Profile views of same patient. The scars resulting from the plastic operations have been excised and resutured. An inlay graft (Waldron type) was used to deepen the inferior dentolabial fornix. The chin has been rounded out with a deep injection of cold paraffin because the patient wished to avoid another such a serious operation as a cartilage graft (see Figure 9f). In spite of the prevalent and wise prejudice against its use, I believe that the injection of cold paraffin in a solid mass is free

were retained by a contrivance made by Captain Dameron. In this way about seven-eights of an inch in the length of the body of the jaw was gained on each side. This procedure is shown in Figure 8a. The second step was to reconstruct the upper lip by cutting the flaps "A" and "B" through the full thickness of the cheek, and, after freeing the distorted floor of the right nostril, these two flaps were rotated downward and sutured in place forming the upper lip shown in the right photograph, Figure 9a.

Fig. 10a. Fig. 10a. Fig. 10b Fig. 10b.

Figure 9b. To obtain material for the lower lip and chin including the mental part of the mandible, the flap outlined in Figure 9b, left photograph,which include the head and 3 inches of the full thickness of the clavicle, was raised up and sutured back in its bed-delayed transplantation. This was done under novocaine. A subsequent bronchitis precluded transferring this flap and several months elapsed before the flap was again raised up and again re-sutured in its bed, preparatory to transfer. This time the tip of the flap became gangrenous, as shown in the right photograph. Ten days later the skin covering the chin area and the lower lip were split vertically in the mid-line and a transverse incision was made on the chin surface below (right hand picture Figure 9c). The resulting flaps were dissected laterally, exposing the free ends of mandible on each side. That on the left was shorter than on the right but in twisting the pedicle to throw the skin surface forward the head of the clavicle was brought in contact with the end of the shorter left mandible which compensated for its shortness and allowed the graft to lie transversely. The chin and the right two-thirds of the lower lip, external and

Fig. 11a.

Fig. 11b. Fig. 11b. Fig. 11c. Fig. 11c.

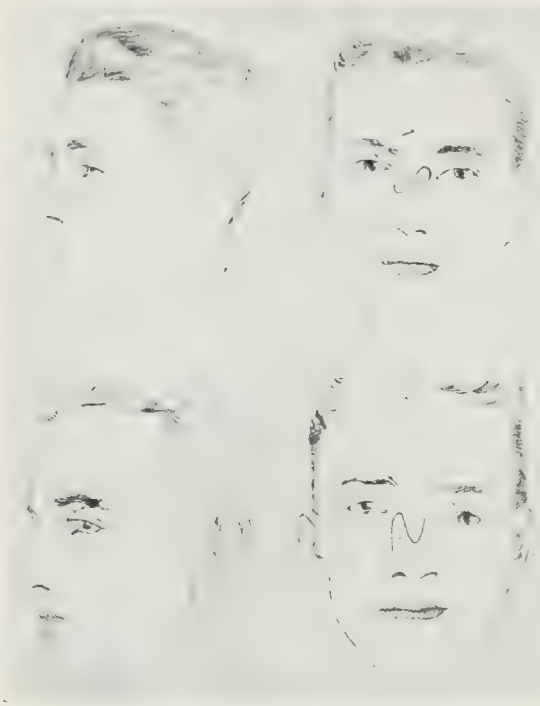

Fig. 12a.

internal surfaces, were reproduced in this way, and by suturing the intra-oral skin to the freed sublingual mucosa, the upper surface of the graft was entirely covered.

Figure 9c shows the manner in which the flap was transferred. Some time before the clavicle flap was placed in the chin, a little plastic operation was done on the lower lip to help prevent the dribbling of saliva, which in these cases is very annoying. The plan of this operation is shown in the two central sketches, Figure 9c.

Figure 9d shows the result of the placing of the chest-clavicle flap in the chin after the pedicle had been cut and returned to the neck. It looked like a big flap when it was made but if it had been twice as broad the result would have been very much better.

Figure 9e shows a front view of the condition on arrival at the reconstruction hospital and of the final condition after the point of the chin had been rounded out with a cartilage graft and making some adjustments of the lower lip.

Figure 9f. The right hand photograph shows side view of the case after the cartilage transplant was made. The distance from the columella to the tip of the chin is greater than the ordinary formulæ for good facial balance calls for but this helps to neutralize the very prominent nose. The full extent of the original deformity can not be appreciated from the left hand picture because it is not a true profile. Later, after the labio-alveolar fornix was reconstructed with a skin graft Captain Dameron fitted him with a denture.

Figure 9g is a roentgenogram of the clavicle graft in place, bony union having occurred and the wire not having been removed. Note that on the right side, the graft was a bit short and had only slight contact with the jaw bone, but a growth of bone has bridged the space. On the left side, because the remaining part of the body of the jaw was shorter than the right, the edge of the head of the clavicle was placed against the end of the body of the jaw so as to throw the graft as far forward as possible. Note that the prominent border of the head of the clavicle has been absorbed all around except where in contact with the jaw and here the contact has been strengthened by a deposit of bone. This is but another illustration of the truth and force of Lane's definition of bone; "ossification in the lines of force."

Figures 10a and 10b. An injury of which there were relatively few instances during the war was clipping out the root of the nose and, unfortunately, usually associated with the loss of one or both eyes.

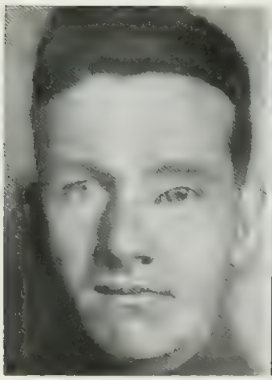

Fig. 12b.

Fig. 12b.

Fig. 12c.

Fig. 12c.

Fig. 13a.

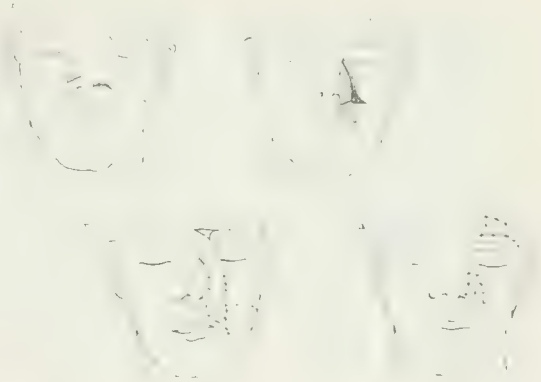

Fig. 13c.

Fig. 13b. Fig. 13b. Fig. 13d. Fig. 13g. Fig. 13g.

Fig. 13e.

Fig. 13f.

In this case though both eyes are gone, the lids are undamaged. The correction consisted in first cutting out all scar which allowed the tissues to retract, reproducing the original defect, and then turning a flap from the forehead which was sutured in such a way as to restore the contour of the bridge.

Figure 10b shows the result of operation in this case. If the defect to be bridged was very large, an osteoplastic flap was made of the periosteum and a strip of bone covering the frontal sinus and this was turned down on a hinge of periosteum and muscle so that what was the outer surface of the upper end of the strip of bone comes to rest on the upper end of what remains of the bridge of the nose. In one case so treated, pus was found in the opened frontal sinus: permanent drainage was established and the operation continued. After the bridge of bone is in place the covering flap of skin is turned down to cover it. This flap may be made at the same time to repair an eyelid.

Figures 11a, 11b, and 11c. Figure 11a shows a case in which the nasal injury is combined with an injury of the upper eyelid. The central figure

Fig. 13h. Fig. 13h. Fig. 13i. Fig. 13i.

shows the forehead flap turned into place and the forehead defect converted into a linear wound. In placing this flap, the inner end of the right eyelid was forced to an abnormally high position. The right hand figure shows subsequent correction of this by a "Z" incision and switching the flaps.

Figures 11b and 11c are profile and front views of the case illustrated in Figure 11a, showing the condition as he came to the rescontruction hospital, and also upon his discharge.

Figures 12a, 12b, and 12c. Figure 12a drawings of a case following an open fracture of the nose with considerable laceration of the soft parts. The bone bridge was depressed and displaced laterally. The upper left hand picture shows the lateral view, while that to the right is a front view with the flaps for correction outlined on the surface. The "A" flap included the full thickness of the nasal bones, and was raised from its bed with a chisel, and fractured across its base. The "B" flap was of the soft tissues only. After the "B" flap was raised the tip of the "A" flap was brought to the left so that it rested upon the lower boundary of the notch, while the "B" flap was switched to the right to take the place of the "A" flap, as shown in the lower right right hand figures.

Figures 12b and 12c show the case before the operation and the result of the operation. It also shows a downward displacement of the inner canthus only partially corrected at this time. The downward depression of the inner canthus in these cases where the scars go through the nasal and lachrymal bones consist in the removal of the lachrymal sac and cutting a tongue-shaped flap from the upper eyelid, base on the root of the nose, and switching it into an incision made transversely just below the canthus after the canthus has been moved up to its proper position.

Figures 13a, 13b, 13c, 13d, 13e, 13f, 13g, 13h, 13i, Figure 13a are drawings of the right side of a face that was very much damaged by shell. The damage to the nose is shown in this and in subsequent figures, but the depression and loss of bone below the right eye socket does not show. The shaded areas in the upper left figure represent the scar excision. The undermining beneath "E" was just beneath the skin while that under "A" and "D" was just superficial to the periosteum. After the flap "A" consisting of skin and superficial fascia was raised from its bed (lower left figure), the deep surface of the subjacent deep tissues was superimposed on the subcutaneous tissue under "E," as shown in the upper central figure thus partially filling the hollow below the socket, approximating "D" to "E" and raising the right corner of the mouth. Then the skin flaps "E" and "D" were sutured and the "A" flap placed between "C" and "B" as shown in the lower right figure. Later the flattened nasal bones were chiseled free from the nasal processes of the maxillæ, pried forward and held there by a dental splint, as shown in the upper right figure and in 13b. The left hand photograph shows the splint in place anchored to the teeth. The one to the right also shows the left ala to be entirely missing and a deep scar on the cheek. This splint was made by Capt. Dameron, D.C., U. S. A.

Figure 13c illustrates how the material for the left ala was obtained. The scar in the left cheek was excised. The flaps "A" and "B" were outlined, "B" was raised and sutured raw surface out, into the defect in the left side of the nose after the scar was removed. It was then covered by the "A" flap, as shown in lower left hand figure. Later the "A" pedicle was cut and the unused parts returned to the forehead. This produced the condition shown in Fig. 13d. The thickness of the ala was reduced by subcutaneous excisions and, by the operations shown in Fig. 13e, the crease between the ala and cheek was reproduced. It was further deepened by lining the depth of the excision with a (Thiersch) graft. The part of this deformity dependent upon the depression of the right lower lid was corrected by switching a flap from the temple into the cheek just below the lid and also by implanting a piece of costal cartilage into the defect in the lower border of the orbit. A piece of cartilage was also implanted into the nose, see Figures 13f and 13g, a stage in the progress of the case.

Fig. 14a-1.

Fig. 14c. Fig. 14e.

Fig. 14a-2.

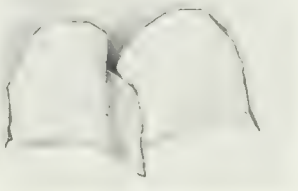

Fig. 14b.

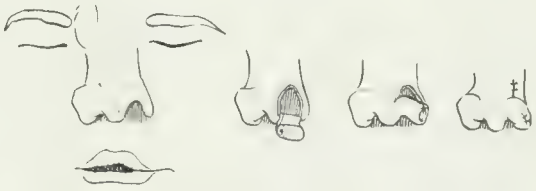

Fig. 14d.

Fig. 14f. Fig. 14f. Fig. 14g. Fig. 14g.

Figures 13h and 13i show the front and profile view as they were on entering the hospital and as they appeared near the completion of the case. The stare that remains about the right eye is due to poor action of the upper lid dependent on a badly fitting artificial eye. Note that the relation of the margin of the lower lid to the iris is about the same in each eye. The full extent of the original deformity cannot be gaged from Figure 13i, because it is not a true profile. The true profile position to the ordinary photographer of commerce is like the giraffe to the farmer. "There ain't no such animal." On the other hand Miss Hance has by the skillful use of lights entirely eliminated the cheek scar which though not depressed still shows on the man.

Figures 14a, 14b, 14c, 14d, 14e, 14f, and 14g. Figure 14a shows a soldier who had extensive destruction of the nose and left maxilla with a downward slump of the left lip, cheek, palpebral fissure, and eyeball. The cartilage on the forehead had previously been implanted for the purpose of making the nasal bridge. This cartilage was not used, however, and was later removed. The first steps of the final plan of reconstruction are shown in Figure 14a-2. On a plaster cast of the patient a clay nose has been modeled. From this clay nose a tinfoil pattern was made which later was used to outline the flap on the forehead and its plan of implantation laid out.

Figure 14b is a drawing of the tinfoil pattern of the flap folded in the manner it was used (you are supposed to be looking at the inner surface). The double fold in the center is the future columella and septum while the surfaces on either side of this represent the skin lining of the nostrils. The main part of the flap has its skin surface away from you and part of the raw surface is exposed. This uncovered area will be applied to the raw surface of the trap-door flap to be turned downward from between the eyebrows. The dotted line on the folded tinfoil pattern is to indicate the actual length of the future nose. The extra amount of the flap below this will be required to make the fold that will constitute the edge of the nostrils.

Figure 14c shows appearance when this flap was first turned down into place. Notice that on his left side an attempt was made to utilize a part of the original ala. This was a great mistake and necessitated the series of operations shown in Figure 14d, and the resulting irregularities have never been entirely smoothed out. It is often better to eliminate a distorted ala and make an entire new one.

Figure 14e. The photograph to the left shows an almost front view of patient as he came to the reconstruction hospital. The picture to the right shows result of implanting costal cartilage and shaping up the flap. Note that the left eye is still lower than the right. The slump of the left upper lip and depression of the eyeball and palpebral fissure have been partially corrected by plastics, skin graft, and cartilage implant, but this point is still being worked upon.

Figure 14f is a side view, from the left, of condition on entering reconstruction hospital and also at the present time. Note scars from operations on reconstructed ala.

Figure 14g. Corresponding views from the right. Note that the upper lip has been raised and given a better shape by turning in part of the original skin of the nose to extend the floor of the nares forward. Note also the columella and the new ala.

GRANULOMA INGUINALE[1]

By ALEXANDER RANDALL, F.A.C.S., JAMES C. SMALL, M.D.
AND
WILLIAM P. BELK, M.D., PHILADELPHIA

FOLLOWING the illustrated report in May, 1920, by Symmers and Frost (18) of the finding of two cases of granuloma inguinale in Bellevue Hospital, New York, we were inclined to feel that similar cases had been seen in this vicinity, especially in the wards of the Philadelphia General Hospital.

Beginning January 1, 1921, a search was instituted with the startling result that *five* men and *two* women were found at that time in the wards suffering from granuloma inguinale in its varying forms. Clinical studies and laboratory investigations were started at once, and we wish herein to report the results of these preliminary studies carried on during the past 7 months. Subsequent admissions have raised the total number of cases to sixteen.

INCIDENCE OF THE DISEASE

There is not the slightest doubt that this supposedly tropical disease has been endemic in the vicinity of Philadelphia for the past 50 years at least. In the accurate recollections of men, both physicians and ward attendants, who have been in charge of the genito-urinary services, the condition has been recognized, though wrongly diagnosed, for the past 25 years. We have been fortunate in acquiring some photographs, made for the late Orville Horwitz, showing similar lesions that he was familiar with during his long services in the hospital, though again masquerading under a mistaken diagnosis.

It is conservative to say that 15 or more patients are admitted to this hospital yearly suffering from this disease. They receive some treatment, gain some improvement, leave the institution; and it has been the experience of those in charge that the majority return because of a recurrence of the condition within the following 2 years. The varying manifestations of the disease do not always place them in the genito-urinary wards, and patients have been observed in the dermatological, surgical, gynecological, and obstetrical wards. That the condition is endemic elsewhere in the country is practically assured. Lippincott, of Camden, has furnished us with one of our cases and has seen others since its recognition. Ross, of Richmond, has a group of cases found in Robert Bryan's clinic. Geraghty, of Baltimore, reports that he has seen the condition repeatedly in the Hopkins clinic. Walker (19) reports a case seen in San Francisco, though an importation of the disease acquired in South America. Campbell has recently reported cases from Bellevue Hospital, New York, with the citation of cases reported from other parts of the country.

HISTORY

The most complete study of the condition exists in the work of Aragao and Vianna (2), of Rio Janerio, where the disease has been present constantly and recognized for a number of years. Rio Janerio is in a southern latitude corresponding to a point between Florida and Cuba in the northern hemisphere. Within these geographical limits the condition has been met with repeatedly and hence the erroneous assumption that it is a tropical disease has prevailed. Its peculiar predilection for the negro has possibly made this assumption seem more of a fact.

The literature contains numerous scattered observations relative to the clinical aspects of small groups of cases of granuloma inguinale or the use of tartar emetic intravenously in its treatment. Cummings (7) treated a patient with antimony and potassium tartrate intramuscularly. Hoffman (10) has published a recent clinical study from Germany treating his observed cases intra-

[1] Received for publication in October, 1921

venously. Reed and Wolf (15) have encountered the disease in New Orleans and have successfully treated it with antimony intravenously. Cuthbert (8) reports a case from England similarly treated. Aragao (1) in a recent article brings his bacteriological studies up to date, claiming that though the organism originally described by Donovan is easily found in smears and is pathognomic, yet it has never been cultivated. Campbell (4) reports three further patients observed in Bellevue Hospital.

The use of antimony and potassium tartrate (tartar emetic) as an intravenous medicament, has been gaining ground rapidly. Aragao and Vianna, in 1912, were the first to point out its value and almost specific action in granuloma inguinale. Recent literature contains numerous references to its use and beneficial action in bilharziasis (17, 11, 14), filariasis (12), gangosa (6), cachar sore (16), malaria (3), leishmaniasis (5) and trypanosomiasis (5). The future seems brilliant for this erstwhile popular and almost discarded drug with the possibility of other synthetic compounds.

Our first presentation of patients was on January 24, 1921, before the Philadelphia Urological Society, with subsequent public expositions of the progress of the work as follows: Philadelphia Urological Society, March 28, 1921; American Association of Genito-Urinary Surgeons (Richmond, Virginia) May 3, 1921, and the Philadelphia Pathological Society, May 26, 1921. We likewise published a preliminary report in the *Journal of Urology* June, 1921.

CHARACTER OF LESIONS

The usual history is that the lesion started as a small papule, non-inflamatory, which after rupture and the exudation of slightly purulent fluid, refused to heal, and exhibited progressive tendencies toward slow proliferation and spreading. The typical lesion (especially seen when involving the inguinal region), is a flesh-red, exuberant, overgrowth of soft granulation tissue. A wire loop for making cultures can be pushed into this soft tissue to the depth of several millimeters. It has absolutely no similarity to an ulcer, with its eroding, undermining edges, and necrotic base. The center of the granuloma appears slightly depressed, and there is certainly a destructive action present, but the edges are redundant and overlap the apparently healthy skin margin to the height of 6 to 8 millimeters. Exudate is scant, mucoid in character, of a non-offensive odor, and when wiped with gauze is easily removed, leaving a clean, red, bleeding surface, similar in every respect to a large area of healthy granulation tissue as seen in clean surgical wounds. This picture varies according to the duration size, and location. The older lesions show at times tendencies toward cicatrization at some points, while spreading in others, but this occurs only when flat, non-chafing surfaces are involved. Large lesions, especially those of the perineum, become bulbous, simulating condylomata acuminata, with large rounded heads of new-growth, the heads ofttimes with pearly white surfaces of epithelization, and deep crypts with raw granulomatous surfaces. Secondary infection here causes the clean, odorless character to change.

As indicated by the name, the most frequent location is in the groin spreading upward as far as the anterior superior spine and downward through the fold of the groin, frequently involving the perineum, and in some cases following the fold of the nates and spreading to the buttocks. Prepucial lesions are likewise frequently associated and at times primary, and involvement here has given us the most destructive picture with a gradual erosion of the glans and even the shaft of the penis. In the male we have had 4 cases where the lesion was limited to the groin alone: 2 cases of penile involvement; 1 limited to the anal region alone; and the remainder with multiple involvement including the perineum.

In the female the labia majora suffer most, though groin lesions are again characteristic; and once the external genitalia become involved, the entire vulvoperineal region suffers and the spread is the same as in the male. We have observed extension in two cases into the vagina and rectum. The labia swell enormously and become almost elephantine.

In certain patients the history apparently points to a granuloma infection superimposed upon a prior existent genital lesion.

SYMPTOMS

The patient has few subjective symptoms. They suffer no pain or discomfort unless the involved areas are so placed as to cause chafing. The granuloma is practically painless to the touch, and only deep pinching up of the mass will cause suffering. Practically all of our patients have shown a marked degree of secondary anæmia, but there has been a complete absence of pyrexia, chill, leucocytosis, throbbing, lassitude, or the usual concomitants of infectious processes. Their blood counts show a decrease in red cells commeasurate to their anæmia. No leucocytosis, eosinophilia or other characteristic change has been observed in the white blood cells. Fragility tests and blood-platelet counts are likewise normal.

Wassermann tests have been negative with a few exceptions where undoubtedly a double infection has been present, and in these energetic antiluetic treatment has been devoid of effect upon the granuloma, and no other evidence of lues has been present (where the Wassermann test was positive) except a history of prior infection.

RACE

All of our cases, with one exception, have occurred in the negro. The one exception is that of a white male, in whom the lesion has likewise been atypical, simulating a phagodenic chancroidal sore with ragged ulcerated edges. His bacteriological examination was positive and he may be harboring a double infection. He, however, has responded to treatment slowly, and healing has progressed under specific treatment with antimony, after being entirely rebellious to arsenic and all local applications, though it must be recorded that complete and permanent cure has not been obtained in his case to date.

DIAGNOSIS

We have based our diagnosis on the fairly characteristic clinical pictures, and also especially on the bacteriological findings of the specific organism. This latter is done by making smears from the exuding surface, in which will be found numerous large mononuclear plasma cells the protoplasm of which, on proper staining, will be found studded with the characteristic encapsulated bacillus originally described by Donovan. The therapeutic result from the use of antimony intravenously may likewise be taken as indicative of the accuracy of the diagnosis, for, after three or four administrations, the organism disappears entirely from the surface and cannot be found in the smears, and healing promptly follows.

That the condition has been constantly present in the hospital wards of this vicinity carries with it the necessity that it has masqueraded under other and faulty diagnoses. Many have been considered chancroidal sores to which it bears no relation (except where secondarily infected as in the perineal lesions), for the ulcerated, undermined edges and the foul purulent discharge are absent. Tertiary syphilis with its varying manifestations has claimed others, especially before the days of the Wassermann test and arsenic therapy. Condylomata acuminata, especially when seen in the female, may have been confusing, while condylomata lata bear close resemblance to the lesion of granuloma when the latter occur about the anus (see Case 6).

In our genito-urinary wards, the diagnosis has been for the past two decades tuberculosis cutis, and this I find was what the late Orville Horwitz considered it. A. A. Uhle, shortly before his death, was interested in the etiology of these cases, and in conjunction with Randle Rosenberger undertook some investigations in an attempt to establish the tuberculous nature of the lesion but, failing to demonstrate to their satisfaction that this infection was present, carried the work no further. Its similarity to lupus and the improvement under X-ray therapy was always held as the sole argument in favor of this diagnosis.

Any pudendal sore, resistant to the ordinary surgical antiseptics, unimproved by arsenical therapy, of long duration, and especially when devoid of pain, should be searched

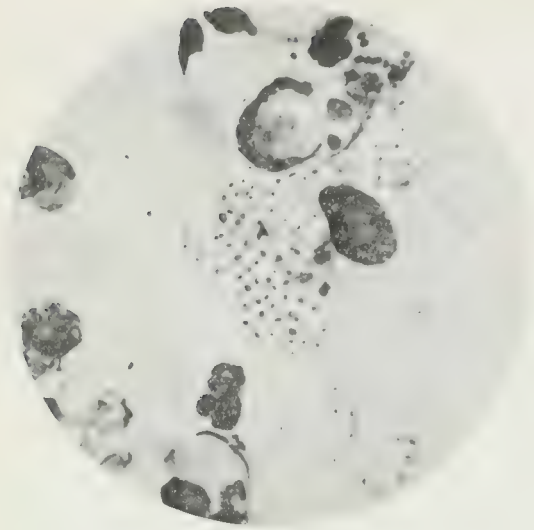

Fig. 1. Smear from lesion. Wright's stain. x, 800. Donovan's organisms in and about mononuclear cells. A rounded "nest" of non-encapsulated organisms appears in the disintegrating cytoplasm of one of the cells.

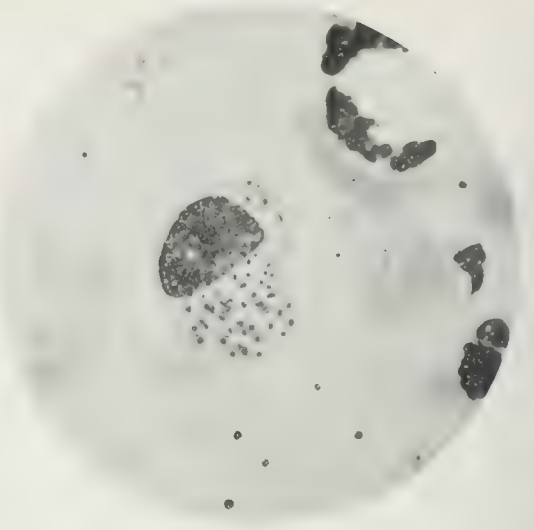

Fig. 2. Smear from lesion; Wright's stain. x, 1200. Intact mononuclear cell showing cytoplasm studded with Donovan's organisms—capsules narrow or absent.

for the specific organism of granuloma inguinale and given the advantage of antimonial treatment.

BACTERIOLOGICAL METHODS AND DIAGNOSIS

Direct smears from the lesions, properly prepared and stained, constitute a very reliable method of diagnosis. The material is best collected by means of a stiff inoculating wire loop which can be inserted quite deeply into the friable granulations of the lesions, rotated gently and withdrawn quickly in order to bring an inoculum from the deeper parts. Surface contamination can be minimized by first sponging off any surface exudate with sterile gauze. Suitable material for diagnostic smears may be obtained also on small cotton swabs from such a cleansed surface of the lesion, but where cultures are to be attempted material from the deeper parts of the lesion is to be desired. Thin spreads of this material are essential. These are dried quickly in air and stained either by the Wright's or the Giemsa method. Wright's staining is the more rapid and has given satisfactory results. The proper differentiation of the stained smear in distilled water is the chief technical difficulty. Even with the most intense staining this differentiation should not be carried out for more than 15 or 20 seconds. Overdifferentiation completely decolorizes the capsules of the organisms; while underdifferentiation fails to bring out detail and contrast between the body proper and the capsule.

The best staining results show the organisms as small, rounded, pink bodies with a dark blue coccoid body in the center; or, more frequently as oval pink bodies with a blue bacillary or diplococcoid body occupying the longitudinal axis. The pink outer zone is a wide capsule. The dark blue central bodies represent metachromatic granules within the body proper. The true outline of the body proper can be studied only after the capsule has been entirely decolorized.

In stained preparations from the lesions, some areas will show organisms with the capsules stained a pale blue and with obscurely differentiated central bodies; other areas will show well-defined dark blue metachromatic granules surrounded by a pink capsule; and still other areas where the capsules have been entirely destained and in which the organisms appear as short, thick bacilli with blunt, rounded ends occupied by the dark blue metachromatic granules, presenting a true bipolar stained appearance with the intervening body shaft stained a pale

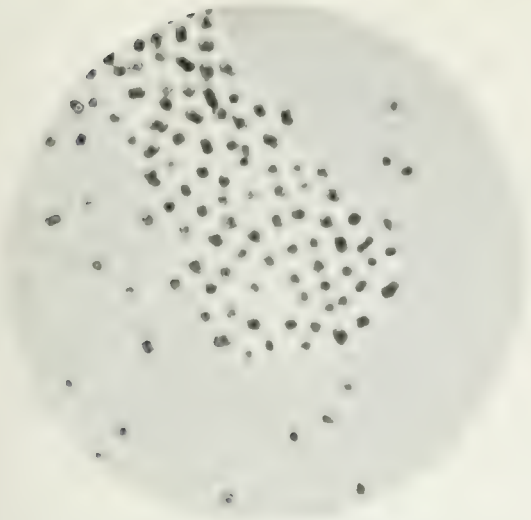

Fig. 3. Preparation from acid dextrose agar culture; Wright's stain. x, 1200. Capsules stained, typical morphology.

Fig. 4. Young broth culture; Wright's stain. x, 800. Bipolar staining and solid staining of organisms. No capsules.

blue. Always a few organisms, usually shorter than those just described, are seen to stain solidly a deep blue.

The organisms are found within the cytoplasm of large mononuclear cells. In such they either have well-defined capsules, or appear in nests occupying a rounded area within the cell and revealing no capsules. Within these nests the bipolar staining may at times be observed. The polymorphonuclear leucocytes do not contain encapsulated forms. Encapsulated organisms may appear free, or in relation to cellular detritus, chiefly in groups and in the neighborhood of large naked nuclei of disintegrating mononuclear cells.

Smears from the lesions are remarkably sparse in other bacteria as compared with smear preparations from the other types of ulcerative lesions about the genitalia. Staphylococci, streptococci, diphtheroid bacilli, and bacilli of the morphology and staining characters of the colon group may be observed widely scattered, or grouped within the polymorphonuclear leucocytes.

Cultures from the lesions. Material collected from the lesions has been inoculated on various types of media and grown under different conditions. In the cases of three patients an organism has been obtained, which, in stained preparations from the cultures, resembles the organisms seen in the mononuclear cells in stained preparations of the exudate directly from the lesions. Failure to obtain this organism in cultures from all the lesions as well as subsequent failure to produce chronic lesions in animals by inoculation of the organisms, has led us to study carefully the different bacteria growing in cultures from the lesions. The general plan of this study will be mentioned later.

Aragao and Vianna (2) called attention to an organism grown in three of seven granuloma lesions studied, and described it under the name of calymmatobacterium granulomatis. Their description of this organism places it within the group of gram-negative encapsulated bacilli and does not differentiate it from the bacillus mucosus capsulatus group sufficiently to warrant its separate classification and new nomenclature. They presented this organism as the specific causative agent of granuloma inguinale on rather incomplete evidence. Since then one of them (Aragao, 1) has reported further studies with the conclusion that the organism described by them in cultures is not the causative agent of the disease, stating further that the specific organism has not been cultured. Walker (19)

in one case isolated a gram-negative, encapsulated bacillus. He was unable to produce chronic granulomatous lesions in animals, nor in several instances in men. Lynch (13) has grown an organism in his cases but does not describe it.

In our study, plate cultures have been made on acid dextrose agar (Ph. 6.6) and infusion blood agar (Ph. 7.4) by surface inoculation and incubated at 37° C. Material from the lesions has also been inoculated heavily into tubes containing about 5 cubic centimeters of peptone water. From such tubes after several hours' incubation at 37° C., anaerobic and partial oxygen tension cultures have been made. Plate cultures on Sabourauds medium have been carried at 20° C. for long incubation periods and studied for molds and yeasts.

In all cultures search was made first for organisms which, when stained with Wright's stain, might present any of the distinctive staining and morphologic characters of the organisms uniformly found in the direct smear preparations from the lesions. This required the isolation of organisms in pure culture and growth in many subcultures in order that the morphology and staining properties might be observed for the growths of the particular organism on various kinds of media. Where an organism of the encapsulated, gram-negative bacillus group was isolated, the strain was preserved to be subjected to detailed bacteriological study. The finding of such a strain did not modify the more tedious study of the morphology and staining properties of the other organisms appearing in the primary cultures from any particular patient. The protean-staining results with a Romanowsky stain are soon very well appreciated when it is employed in such a study of bacteria. Repeated stained preparations of an organism are frequently necessary in order to exclude these aberrant results which may present appearances suggestive of the metachromatic staining constantly observed in the Donovan organisms of the direct smears from granuloma lesions. The organisms found to present these staining characters, with any degree of consistency, were next subjected to tests planned to demonstrate the effect of tartar emetic upon their growth in suitable media in the test tube. If any appreciable inhibitory effect was noted, animals were inoculated intraperitoneally, cutaneously, and subcutaneously. The general plan of this animal experimental work was first to inoculate large doses of the culture intraperitoneally into white mice. At 2, 4, and 6 hours after inoculation, stained preparations of the peritoneal exudate were made to determine, first, the character of the cellular reaction (whether mononuclear or polymorphonuclear); second, the type of cell phagocytosing the bacteria injected; third, to study the morphology and staining of the bacteria as they occurred free in the exudate or included in the cells; and fourth, to gain some idea of the pathogenicity of the organism for white mice. In some instances guinea pigs were used also in the same manner as the mice.

Animals inoculated cutaneously and subcutaneously were observed over long periods for the development of lesions, which latter appearing were studied from time to time by means of stained smears and by cultures.

By employing the above methods in the cases of 12 patients, in all of whom the Donovan organisms were found in the direct smears from the lesions, we have obtained an organism in culture closely resembling these bodies in three instances. These organisms have proved to be encapsulated bacilli of the bacillus mucosus capsulatus group, and very probably correspond to the organisms reported by other workers in cultures from similar lesions. They grow freely on all the ordinary culture media and their growth is favored by an acid reaction. The acidity of the media may be increased to a point where the growth of the ordinary contaminating bacteria is markedly inhibited before any appreciable inhibition of the growth of this organism is observed. This is especially true if a simple carbohydrate is added to the media.

The surface growth of these organisms is quite characteristically that of the Friedlaender bacillus. The colonies appear as slightly gray-white, translucent, glistening, dome-shaped elevations on round regular bases from 1 to 3 millimeters in diameter.

When touched with an inoculating wire they appear quite viscid, having the appearance and consistency of thin starch paste. By transmitted light they are translucent and have a slightly brownish tinge. They are usually the largest colonies appearing in the mixed primary cultures and are very readily recognized. In subcultures the growth is profuse on all the simpler laboratory media and the growth on agar, gelatin, or coagulated blood serum does not differ essentially from that described above. In fluid media diffuse turbidity develops with a surface ring of growth tending to adhere to the sides of the tube and to climb slightly above the level of the liquid. Later sedimentation occurs. Growth is profuse even in 1 per cent peptone water. In litmus milk, there is acid formation and coagulation within 24 hours. On potato growth is abundant, moist and brown, with decided blackening of the potato.

In stained smears preferably from the acid glucose agar cultures, wide capsules are easily demonstrated, so that the organisms appear as do the Donovan organisms in the exudate from the lesions. In the stained smears from broth cultures, the capsules are not demonstrated, the organisms appearing as short, plump bacilli, exhibiting irregular staining, for the most part showing a dark area at either pole, with a pale, intervening area. In old cultures, especially in a medium containing a carbohydrate which has fermented with decided acid production, long forms are found. These forms also stain irregularly, presenting dark blue, banded areas, alternating with pale areas throughout the length of the organism.

The organism is a gram negative, nonmotile, non-sporulent, encapsulated bacillus, which shows metachromatic granules as well as capsules with Romanowsky staining. It does not liquefy gelatin or coagulate serum. Freshly isolated cultures hæmolize blood. Milk is coagulated and acidified. Indol is not produced. The organism ferments dextrose, levulose, lactose, galactose, saccharose, maltose, mannit, arabinose, salicin, inulin, and dextrin. It does not ferment dulcit nor rice starch.

Repeated cultures have failed to yield this organism in the other patients, so that a thorough search of the bacteria growing in all the primary cultures was conducted to determine whether among the colonies growing there might be organisms showing other gross cultural characters, but which might upon proper staining show some of the characteristics of the Donovan bodies. Many strains of different bacteria have been isolated because of some suggestive staining property with the Wright's stain and a number of these have been carried through to animal inoculation for the purpose of studying the appearance of the particular organism in the animal exudates. In no instance was found an organism which tended to occur in the mononuclear cells, although in many such exudates when examined within 6 hours after inoculation there appeared considerable numbers of mononuclear cells. The morphology of Donovan organisms was not approximated by any of the organisms examined in these exudates, except by the three strains of encapsulated bacilli as mentioned above.

Animal inoculations. The three strains of encapsulated bacilli isolated from granuloma lesions have been studied in detail by experiments in which six strains of the bacillus mucosus capsulatus group (Friedlaender's) isolated from the throats, sputum, and empyema fluid of patients in this hospital have been carried in parallel experiments. These experiments will be reported in a subsequent paper; we simply say at this time that these studies have failed to show any distinctive properties which might serve to differentiate the strains of granuloma origin from those of respiratory origin. Lesions produced in experimental animals with strains of granuloma origin may just as easily be produced with strains of respiratory origin and in our experience the lesions appear identical.

Experiments with strains of granuloma origin. Intraperitoneal inoculations of mice and guinea pigs have proved rapidly fatal. The exudate when examined early, 2, 4, and 6 hours after inoculation, shows a mononuclear cell reaction; later the polymorphonuclear cells predominate. The bacteria occur for the most part free in the fluid and present wide capsules. They resemble the Donovan bodies with well-developed capsules. Some

when superimposed on the mononuclear cells are very characteristic, but the rounded nests of bacteria, showing only narrow capsules or no capsules, lying unmistakenly within the mononuclear cell cytoplasm, have in no instances been observed.

Cutaneous inoculations of mice, guinea pigs, rabbits, cats, and dogs have invariably failed to produce lesions. Abraded skin areas over the arm of an adult colored male (Case 12) were inoculated, (a) with granuloma strain I; (b) with granuloma strain II; (c) with a strain of Friedlaender's bacillus of mouth origin; and (d) with sterile normal salt solution. These were observed for a period of 19 days before the treatment with tartar emetic was started. All crusted over and healed promptly.[1]

Subcutaneous inoculations of guinea pigs, cats, and dogs have failed to produce lesions. Subcutaneous inoculations of mice have at times resulted in the death of the animal from a generalized infection; at other times in abscess formation which healed promptly either with or without breaking down with ulcer formation.

Subcutaneous inoculations of rabbits with 1 cubic centimeter of broth culture of the organisms have produced focal lesions. Beginning as firm, indurated masses, they appeared after 7 to 10 days as large doughy abscesses. These might point in one or more places, breaking down to form well-defined ulcers in the depths of which appeared the tough, cheesy, necrotic material which we have come to regard as the typical contents of abscesses produced experimentally in rabbits by the Friedlaender bacillus. These abscesses drained imperfectly through the spontaneous openings. Firm pressure on the abscess adjacent to the ulcer expressed the necrotic material and tended to produce some bleeding from the margin as well as from the depths of the ulcer. Evacuation of this material hastened healing. Left to themselves these lesions would heal slowly, the necrotic material being in part thrown off and in part absorbed. The lesions always healed spontaneously in from 3 to 7 weeks after inoculation. In the necrotic material and from the granulations bordering the ulcer, the encapsulated bacilli could be demonstrated by smear and culture. In the smear preparations from the granulating border, the nests of bacteria within mononuclear cells could not be demonstrated. In some cases the typical doughy abscess would not rupture, healing taking place after absorption of the necrotic material.

In mice and rabbits, some experiments were planned with the view of attempting to establish symbolic relations in an experimental lesion between the encapsulated bacilli of granuloma origin and some of the other types of bacteria isolated from granuloma lesions. Bacteria of the staphylococcus, colon, and diphtheroid group were used, being injected simultaneously with the inoculum of the encapsulated bacillus. The lesions produced by the encapsulated bacilli following subcutaneous injection were not modified by this method of inoculation, except in rabbits when injected with staphylococcus aureus, with which abscess formed more promptly and always ruptured spontaneously. The rate of healing did not appear to be affected.

HISTOPATHOLOGY

Stained sections of granuloma inguinale show a superficial cellular area surmounted on a base of dense, hyaline, connective tissue. The transition is rather sudden, but no distinct line of demarcation separates the two elements. The cellular area is composed of a young connective tissue, relatively small in amount, many endothelial leucocytes, and a smaller number of polymorphonuclear neutrophiles. The proportion of the latter varies considerably, appearing most numerous in untreated cases. They are probably an index of secondary infection. Many lymphocytes are also present, and an occasional eosinophile. Blood-vessel formation is present as in any active granulation tissue. At the margin of the granulation, the squamous epithelium of the skin is seen partially destroyed and replaced. Further out this merges into normal skin, under which, however, the subcutaneous tissues are infiltrated for a little distance by round cells. This would indicate that the lesions extend somewhat farther than would appear on superficial inspection of the granulating area.

[1] Recently, in 2 patients, similar inoculations have yielded negative results.

A feature worthy of note is the proliferation of squamous epithelium near the edges of the granuloma, where finger-like projections extend for some distance into the deeper tissues. In some cases this suggested a squamous-cell carcinoma.

After treatment for some time with antimony injections, the dense fibrous tissue is seen to have replaced the granulations to a large extent. Small collections of lymphocytes remain in this fibrous growth, and a smaller number of endothelial cells. Polymorphonuclear cells have entirely disappeared. A bipolar bacillus, without capsule, has been stained (by Giemsa's stain) in tissues, and these have been found only in the large mononuclear cells. The encapsulated organisms described have not been stained in tissues in this laboratory. However, smears made from the tissues immediately prior to fixation, or at the bedside during biopsy, and stained with Wright's stain, showed them in many cases.

Individual pathological studies appear with their case histories. Sections from one of the experimental animals (Rabbit 3) gave the following: Pieces of tissue from the subcutaneous mass in abdominal wall were fixed in 4 per cent formalin in normal sodium chloride and in Schaudin's fixative. The first were stained with hæmatoxylin and eosin, the last with Giemsa's stain. On examination, the following features were noted: a sparse growth of young connective tissue supported a very cellular mass, the cells were endothelioid and polymorphonuclear neutrophiles in about equal numbers; many small lymphocytes and an occasional eosinophile. New blood vessels were rather numerous, and considerable blood was present. Many small areas of necrosis were scattered throughout. In sections stained with Giemsa's stain a few coccoid bodies without capsules were seen in some mononuclear cells, but not in other phagocytes. The picture was strikingly similar to that of untreated granuloma lesions in man, except for the necrotic areas.

PROGNOSIS

As pointed out by all previous writers and substantiated by the histories of cases in the Philadelphia General Hospital in years gone by, the treatment of these lesions has been most disappointing until the present when antimony therapy was first instituted.

Local applications of salves, escharotics, and antiseptics do no good whatsoever; vaccine therapy has failed consistently; excision is followed almost uniformly by recurrence before healing; arsenic is of no benefit; and X-ray alone has been somewhat beneficial, causing a slow cicatrization, but because of the dangers associated with its use, it has been possible to apply it only once every 3 weeks, and therefore requiring on an average from 12 to 18 months to establish healing. Even with X-ray the hospital experience in the years past has been disappointing and probably at least 50 per cent of the cases returned with recurrences.

Some of our present cases have had two or more admissions in passing years for return of their lesions after apparent complete healing under X-ray therapy, while several have been inmates of the institution for so long that they have been put on the hospital's pay-roll and work as laborers about the buildings. That the condition has been in the experience of this hospital the actual cause of the death of the individual can be recalled by some of the older ward attendants, though not experienced in recent years since X-ray therapy has been used. Our personal experience is limited to the amount of destruction seen in Case 16, where the disease is known to have existed 10 years, causing a complete erosion of the penis.

With the proper application of the new antimony therapy the prognosis becomes extremely good, for the brilliant results seen and herein recorded place this drug as one of the small group of actual specific remedial agents and rapid and apparently complete cures can now be expected.

RESULTS

Of our 16 cases, we have accomplished a rapid and apparently complete cure in 15. The one exception is the case of a white male, before mentioned, whose lesion was not typical, whose organisms were not entirely characteristic, but who was given the advantage of the treatment when all other administrations had failed over a period of 7 months.

He has shown definite improvement (nowhere near as rapid as the true cases), but not yet complete healing (Case 14). We have had two recurrences (Cases 6 and 9), both due to early neglect of treatment and both rapidly healed on re-administration of tartar emetic. We have not seen in a single case any alarming symptoms from the use of the drug, and though the abbreviated case reports do not allow of the exposition of the complete case study, suffice it to say, that no blood or urine changes have been noted as evidence of its toxic effect or to contra-indicate its extensive use as a therapeutic agent. The brilliant recoveries that these patients have made from conditions of years' duration and manifold other forms of therapy, have been as inspiring to their attending physicians as they have been satisfactory to the patients themselves, who have appreciated more than any one else their first permanent relief from an apparently incurable condition. Several (Cases 2, 4, and 5) who were markedly anæmic and emaciated, have shown a general systematic inprovement with increase in hæmoglobin and decided increase in body weight.

TREATMENT

Following Vianna's work, we started giving antimony intravenously in the form of tartar emetic. The initial dose of 0.04 gram was used, and this quickly advanced to a maximum dosage of 0.10 gram. Our first treatments were given daily and most patients tolerated this until about ten doses had been given, but nearly all after that amount showed some symptoms of intolerance for the drug. We then began intermitting the daily dosage, governing the time by symptomatic data. This intolerance consisted of rheumatoid pains in the joints associated with stiffness, especially seen in the early morning on rising, most frequently located through the shoulder girdle, and as a rule wearing off during the course of the day. There have not been in any case symptoms of an alarming character.

The drug has been prepared by dissolving 0.1 gram in 10 cubic centimeters of sterile normal saline solution and is best preserved in sealed sterile ampules. Intravenous administration is essential.

The typical encapsulated organisms cannot be demonstrated in smears from the lesion after the second or third dose of the tartar emetic. Healing commences within 48 hours after the first administration, and from then on almost daily progress can be appreciated. Epithelial proliferation starts at the edges and rapidly spreads inward, while often isolated islets of epithelium in the midst of the granuloma, before not seen, or buried, start proliferation in the midst of the lesion and hurry the complete healing.

The phenomena of healing can best be pictured by comparing it to the use of salvarsan in somewhat similar long standing and untreated luetic skin lesions.

In some cases the administration of the drug causes a tingling, pricking sensation in the granuloma, immediately after the injection and ofttimes an excess of mucoid secretion occurs for the first few days. Scabbing over of the surface takes place whenever the raw surfaces are in apposition, and thin crusts form around the periphery of open areas.

The amount of drug administration necessary to complete a cure appears to be commeasurate with the extent of the lesion and the amount of epithelization necessary. Penile and groin lesions heal rapidly, while vulval and perineal, apparently on account of the apposition of surfaces, respond more slowly and show a tendency to dry and scab over first thus causing slower healing.

Through the courtesy of Professor John J. Abel, of the pharmacological department, Johns Hopkins Medical School, we had placed in our hands two synthetic antimony compounds for trial. One of these (sodium antimony thioglycollate), it will be noted, was used in Case 12, with brilliant results, and a further report will be made later.

Our simplest case required but four doses for complete epithelization of an area the size of a silver quarter: this patient then neglected treatment and had a recurrence 6 weeks later. The highest dosage for healing was in one of the females who had 1.96 grams of the drug in 32 injections. Following the advice of Vianna, we have advised all our patients to persist in taking weekly injections after com-

plete healing for at least 12 doses and in none adhering to this procedure have we observed a recurrence.

We wish, in closing to express our gratitude to three of the resident staff of the Philadelphia General Hospital; Drs. R. Bradley, P. P. Bailey and P. E. Lueke, for their personal interest and keen attention, which combined with technical ability of high degree in handling the intravenous medication made these results possible.

CONCLUSIONS

1. Granuloma inguinale, long considered a tropical disease, is endemic in the temperate zone of the United States.

2. Its diagnosis is dependent on (1) the characteristic local lesion, (2) the marked predominance in the negro race, (3) and the finding of the specific organism originally described by Donovan.

3. These organisms we have demonstrated in smears from granuloma lesions in 12 patients in our series of 16. In the other 4 instances laboratory examinations were not made.

4. An encapsulated bacillus, which when stained from cultures, resembles this organism, has been isolated from 3 of the 12 patients studied culturally. This bacillus is a member of the bacillus mucous capsulatus group.

5. The question remains as to whether the organism seen in smears and that obtained in cultures, which appear so similar, are identical.

6. Abscesses with spontaneous rupture and ulcer formation have been produced in rabbits by subcutaneous inoculation. These heal spontaneously in from 3 to 7 weeks and grossly cannot be regarded as granulomata although the walls of these abscesses on histological examination present granulation tissue not to be differentiated from that of the granuloma lesions. Friedlaender's bacillus forms similar lesions.

7. A few experiments attempting to establish symbiotic relationships between the encapsulated bacilli from granuloma lesions and staphylococci, colon bacilli, and diphtheroids in experimental lesions have failed. More work of this nature should be undertaken.

8. Treatment with tartar emetic intravenously acts as a specific, and rapid healing may be expected with the prompt disappearance of the specific organism.

9. We have experienced no contra-indication to the intravenous use of this drug up to doses as high as 0.1 gram.

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CASE REPORTS[1]

Case 1. H. Q., male, negro, age 39, admitted January 3, 1921, complaining of ulceration of left groin, foreskin, and perineum. Patient born in the county bordering Philadelphia, and has spent all of his life hereabouts. He has never been out of the United States, never south of Baltimore nor north of New York City. He had gonorrhœa last spring, preceding the present trouble by 4 or 5 weeks. The condition began about 8 months ago as a small pimple in the left groin; it was only the size of a pin's head and not at all painful. It rapidly grew to the size of a quarter of a dollar, then broke down, discharging a purulent content, and has remained an open lesion ever since. Soon after the appearance of the lesion in the groin, and before the pimple in the groin broke down a similar one developed on the foreskin. This likewise became an open sore and the two have continually increased in size to the present condition. Examination reveals an area two finger breadths broad, extending from the inferior iliac spine down through the inguinal fold onto the perineum, and is the seat of a raw, flesh-red, soft, and oozing granulomatous mass. It is not depressed and ulcerated, but actually raised above the level of the surrounding skin. Similar lesions occur on the left side of the scrotum and encircling the margin of the foreskin preventing its retraction. The

[1] First three case reports in semi detail to show typical histories, types of reaction, mode of administration and promptness of healing. Remaining histories extensively abbreviated on account of space.

center of the large groin sore is depressed, though uniformly covered with the soft, papillomatous proliferations. There is no offensive discharge, but a sanguinous exudate: no pain, except on deep pinching: and no enlargement of the underlying lymph glands.

Laboratory notes. January 25, 1921. Smears, Gram stain, staphylococci, diplococci and diphtheroids. Fontana's stain, few loosely coiled spirochætæ. Geimsa's stain, red blood cells, polymorphonuclears and large mononuclear cells, no granuloma bodies. Cultures, staphylococci, bacillus coli, and diphtheroids. February 1, 1921, smears (Wright's stain) positive for granuloma bodies. Culture on Sabouraud's medium, no growth after 72 hours. February 12, 1921, blood count, hæmoglobin, 45 per cent, red blood cells 1,000,000; white blood cells, 10,700; polymorphonuclear, 60 per cent; lymphocytes, 36 per cent; mononuclears, 2 per cent; eosinophiles, 2 per cent. February 19, 1921, blood count, hæmoglobin, 59 per cent, red blood cells, 3,380,000; white blood cells, 10,150; polymorphonuclear, 55 per cent; lymphocytes, 44 per cent; eosinophiles, 1 per cent. March 28, 1921, fragility test, complete hæmolysis, 0.20. Complete inhibition, 0.44. March 31, 1921, blood platelet count, 460,000. Reticulated reds, 0.52 per cent. April 4, 1921, smears (Wright's) no granuloma bodies. (Treatment started February 11, 1921.) Staphylococci, diphtheroids. Cultures—staphylococci, diphtheroids. NOTE—Cultures at no time from this patient were positive for the Friedlaender-like bacillus.

Histopathology. Section taken from margin of lesion. Fixed in 4 per cent formalin in normal saline and in Schaudin's solution. Stained with hæmatoxylin and eosin, and Giemsa. Showed typical picture as described above. Smear made at bedside, stained by Giemsa, showed encapsulated diplococci forms, intra- and extracellular. Section from prepuce, obtained at circumcision on May 9, 1921, after tartar emetic treatment, shows a small ulcer, pinhead size. Stained as above. Marked fibrosis; minute area containing many lymphocytes, a few endothelial cells, occasional polymorphonuclear cells. The squamous epithelium of the skin appeared practically normal.

Treatment. February 11, 1921, 0.05 gram tartar emetic given intravenously. Fifteen minutes after the injection, patient had a slight chill followed by headache. Urine analysis of today negative throughout. February 12, 1921, 0.05 gram tartar emetic given intravenously. Slept well last night and experienced nothing further than above mentioned chill. Today normal. February 13, 1921, surface of granuloma not so moist as formally, and of a lighter hue with less bleeding. Edges seem somewhat retracted and flattened. No local sensation experienced with the injections. Given 0.05 gram intravenously. February 15, 1921, wound and patient not disturbed yesterday. Dressing today is quite moist with a serous discharge. Edges show marked retraction, and epithelium is apparently spreading inward. Granulations less exuberant. 0.05 gram tartar emetic intravenously. No reaction. February 17, 1921, there is without doubt a decrease in the amount of serum which exudes from the granulations during the past 24 hours. Three little islands of epithelium have made their appearance near the center of the groin lesion. The epithelium from the edges is growing inward. The lesion on the prepuce is definitely smaller, and the amount of induration is decreased, allowing further retraction of the prepuce. 0.08 gram tartar emetic intravenously. No reaction. February 18, 1921, color of granulations is changing from beefy-red to salmon color. Decrease in size of lesion continues. 0.08 gram tartar emetic intravenously. No reaction. February 21, 1921, 0.08 gram tartar emetic intravenously. No reaction. February 22, 1921, 0.10 gram tartar emetic intravenously. No reaction. February 23, 1921, 0.10 gram tartar emetic intravenously. No reaction. February 24, 1921, 0.10 gram tartar emetic intravenously. No reaction. Epithelium has continued to proliferate actively. The islands in the center of the groin lesion now measure ½ by 8 centimeters. No systematic effect noted from injections. Dosage of 0.10 gram given on following dates, March 2, 3, 4, 7, 8, 9, 16, 19, 23, 26, 29, 31, April 11, 15, 19, 26, May 4, 14, 23. May 9, 1921, lesion so far healed that patient was prepared for circumcision and same successfully performed.

CASE 2. M. S., female, negro, age 21, admitted November, 1920, complaining of genital sores. Born and lived in Philadelphia, married, has had three full term pregnancies. Since initial sexual act in 1914, has had yellowish vaginal discharge and 1 month following this the right labium majorum enlarged, and within 1 week, it had become such a size as to cover the opposite labium. It was not painful, nor was there any visible excoriation, abrasion, ulceration, or bleeding. This condition persisted for 1 month, then disappeared in 2 weeks time without any treatment. In December, 1917, she experienced a stinging sensation again in the right labium and found a small "pimple-like" sore there which she broke. Following this several similar sores formed, rather slowly, and coalesced. There was no soreness with these lesions until after 3 months, at which time patient was admitted to the Philadelphia General Hospital (February 13, 1918) because of condition of vulva and 8 months' pregnancy. On examination, pudendal lesions and a left bubo considered syphilitic, Wassermann reported 4+. She was given five doses of arsenobenzol and discharged from hospital, June 20, 1918, having been delivered of a living child, the bubo healed and vulva nearly healed. Patient describes this first lesion as being red, lumpy, bleeding easily, growing rather rapidly and raised off the surface of the skin. During the summer of 1918, she attended the dispensary regularly for antisyphilitic treatment. July 11, 1919, she was readmitted to the hospital. The following notes have been extracted from her history. Complaint, sores on privates which began to break out as soon as she left hospital last year; they have steadily grown worse to date. General appearance is emaciated. Labia are swollen and ulcerated at anus, inguinal lymph glands are markedly swollen. Purulent discharge from vagina. September 11, 1919, labia majora were much swollen; right labium has tumor mass on it, which is hard, firm, not tender. Lower third is denuded of epithelium, on cleansing shows surface ulcerated and granulating. Left labium less swollen than the right, has a soft tumor, tender on pressure: lower fourth ulcerated and granulating. Urethral orifice surrounded by soft, tender, finger-like processes. Inguinal glands much enlarged; ulcerated on left side and nearly healed. Gland on right side open and ulcerating. December 14, 1919, the condition has been pronounced tuberculosis cutis by genital-urinary chief, and syphilis by the skin chief. Patient has had marked antisyphilitic treatment with no improvement. *Laboratory report.* Histological reports: tissue resembles, or is, epithelioma. Bacteriological reports: no tubercle bacilli found in smears. Blood Wassermann, July 12, 1919, 4+. September 18, 1919, negative. October 27, 1919, negative. January 31, 1920, 1+. Constant irregular fever with slight increases in pulse and respiration of irregular character. Fever seldom at or above 101°. Treatment has been practically antisyphilitic all the way through, although five X-ray applications were made, evidently with lupus vulvæ in mind. Patient was discharged in January 1920.

At time of third admission in November, 1920, the patient was in a weakened and emaciated state, her

appetite a capricious affair, she was fretful and nervous, found it difficult to sleep, and had to be moved with extreme care, because of the pain in a very much hypertrophied vulva, the surface of which was granular, nodular, with a tendency to bleed at the slightest provocation. The diagnosis of tuberculosis of the vulva made on her previous admissions was adhered to once more, and confirmed by chief of service. X-ray treatments were instituted at once; she was sent to the X-ray department every 3 weeks, and by the middle of January, 1920, there was evidence of improvement, noted more especially in regard to her general condition, than in the appearance of the local lesion, in fact it was noted on her chart that the granular process on the vulva was becoming more extensive. A section taken in December, 1920, for histological examination was reported as follows: "Tissue shows considerable proliferation of the squamous cell layer, which extends rather deeply into the underlying tissue. No pearls are present; otherwise the section shows a diffuse infiltration by polymorphonuclear cells and there is considerable free hæmorrhage. Diagnosis: chronic inflammatory tissue; suggests lupus. Stain for tubercle bacilli is negative." The latter part of January, 1921, a tentative diagnosis of granuloma inguinale was made, and confirmed by laboratory methods (smears and section). The patient's condition at the time the intravenous injections of the tartrate of antimony and potassium were started, was very poor; she was extremely emaciated, weighing but 87 pounds, the pale color of all of her mucous membranes favored a rather severe secondary anæmia, and, as stated before, she had a rather poor appetite, was irritable and easily hurt when moved. The lesion locally, as follows: *Left inguinale region:* an area 2 centimeters above the Poupart's ligament and parallel with it; measured 7 centimeters in length and varies from 0.5 to 1.5 centimeters in width. The border is irregular in outline, but very definitely raised off the surface of the skin; the color is a vivid red, with small bleeding areas here and there, where the surface has been abraded slightly by the removal of bandage. The surface has a nodular appearance, is slightly moist; there is no evidence of ulceration, the whole affair is a marked piling up and proliferation of granulation tissue. There is a peculiarly offensive odor when the lesion is exposed. No enlargement of the inguinal glands noted. At the borders of the diseased area, there is some evidence of beginning cicatrization. The consistency of the process shows a rather firm tissue, which does not give much pain when the patient is unaware that it is being manipulated. *Right inguinal region:* An elevated scar in practically the identical position as the opposite side, 5 centimeters in length and 0.5 centimeter in width. At the inner end of this cicatrix is an active condition as above noted, circular in form and in size, one-half the area of a dime. *Vulva, perineum and nates:* The entire left labium majorum is covered by this granular tissue, and the opposite labium shows only a very small area of healthy and intact skin. The labia minora are moderately involved, as is the lower part of the vaginal wall. The granulations are continuous onto the perineum on the right side of the cleft, extending as far back as the anus. The vulva is much hypertrophied, the surface is nodular, moist, raw beefsteak appearance and bleeding at various points; the color is reddish, the odor offensive, the border sharply defined from the healthy skin and seripiginous in outline. The tissue has a firm feel and does not cause patient any discomfort when manipulated with moderate care. At the junction of the thighs and the vulva, the condition is present on the limbs, extending only where the vulva comes in contact with the thigh.

Laboratory notes: January 24, 1921, smear—gram positive bacilli; gram negative bacilli. Fontana stain—no spirochætæ. Giemsa stain—no granuloma bodies; no spirochætæ; few polymorphonuclear and mononuclears. Cultures—staphylococci, diphtheroids, streptococci, and a large gram positive encapsulated bacillus (unidentified). January 28, 1921, smear—gram stain—gram positive bacilli and diplococci. Gram negative bacilli. Cultures—plate overgrown with bacillus proteus. Smears show gram negative bacilli, staphylococci and diphtheroids. February 1, 1921, cultures on Sabouraud's medium show no growth after 72 hours. February 15, 1921, hæmoglobin, 70 per cent; red blood cells 3,470,000; white blood cells, 7,000; polymorphonuclears, 46 per cent; lymphocytes, 46 per cent; mononuclears, 3 per cent; transitionals, 3 per cent; eosinophiles, 2 per cent; marked anisocytosis, polychromatophilia, poikilocytosis. March 2, 1921, hæmoglobin, 40 per cent; red blood cells, 3,370,000; white blood cells, 6,600; polymorphonuclears, 45 per cent; lymphocytes, 49 per cent; transitionals, 2 per cent; eosinophiles, 3 per cent; basophiles, 1 per cent. Stipple cells, anisocytosis, polychromatophilia, and achromia. March 9, 1921, blood platelet count—410,000. March 22, 1921, fragility test—complete hæmolysis, 0.20; complete inhibition, 0.44. April 1, 1921, hæmoglobin, 55 per cent; red blood cells, 3,720,000.

Histopathology. Section from granulating area taken January 28, 1921, fixed in Schaudin's solution, stained with Giemsa's stain. Histological picture as above described. Smear stained with Giemsa's stain negative for encapsulated organisms.

Treatment. Treatment for granuloma inguinale was instituted January 29, 1921, the tartar emetic being prepared in 1 per cent solution in sterile water, beginning with a very small dose and increasing gradually each day until maximum dose was reached. January 29, 1921, injected 0.02 gram. No constitutional reaction; during the afternoon, the diseased area was itching continuously. No headache, nor pains in any of the bones of body. January 31, 1921, injected .025 gram. Three minutes following injection, patient complained of dizziness and sensation of fainting, but recovered rapidly; probably due to injecting the solution too quickly. She had a headache during the afternoon and evening, and considerable itching in the lesion. February 1, 1921, injected .03 gram. Drug injected a good deal slower than was done yesterday and no reaction occurred on the table. There is considerable itching beginning 4 hours following administration of solution, and stab-like stinging occurs every few moments, both lasting until about bed time. There is a great deal of secretion on the surface of the granuloma this morning, and the odor has become more marked. Patient complained of headache at vertex following the evening meal. February 2, 1921, injected. 035 gram. The itching and stinging continue, commencing 3 or 4 hours after the injection. There was a good deal of pus-like material on the bandages this morning and much moisture over all of granuloma. February 3, 1921, injected .04 gram. Complains of itching and stinging in the lesion a few hours after injection. The solution causes a good deal of pain in arm and shoulder as it is being injected. Needle slipped out of vein and a bit of drug was injected into tissues; patient immediately cried with pain; hot water bag kept on arm all day. February 4, 1921, arm is slightly swollen and indurated at site of yesterday's injection, where solution went into tissues; very little pain and no sign of abscess. Complains of itching and especially stinging in the granuloma, the surface of which is very moist and bleeds extremely easy. There are several small white areas about the size of a small pea forming in various parts of the growth. At the edges of the healthy skin, new epithelium may be seen growing in over the granulation tissue. Dur-

ing the afternoon the patient complained of a severe backache. February 5, 1921, injection .05 gram. The whole surface of the granuloma is extremely moist, and the odor is very offensive. Considerable stinging is complained of locally. The serum or exudate from the growth stains the pad a pale yellow. February 7, 1921, injection .055 gram. February 8, 1921, injection .06 gram. Complains of itching and stinging, and a good deal of pain is present in the arm and shoulder when the drug is being injected. February 9, 1921, injection .07 gram. Does not note as much itching the last couple of days but the stinging does not abate any. Still complains of immediate pain and stinging up arm and shoulder as the solution is administered. February 10, 1921, injection .075 gram; February 11, 1921, injection .08 gram; February 12, 1921, injection .08 gram; February 14, 1921, injection .05 gram; February 15, 1921, injection .08 gram. Severe vertical headaches and the usual stinging; very little discharge and odor is lessening. There is a considerable amount of new epithelium making its appearance at the outer borders of the granuloma and around the small white patches that made their appearance the third day. February 16, 1921, injection .05 gram. Has had nose-bleed on three successive nights, but not severe. February 17, 1921, no especial complaint, patient is out of bed for past few days, the first time since admission in November. Her appetite and disposition have undergone a marked change for the better. February 18, 1921, injection .10 gram. February 19, 1921, injection of .11 gram. Epithelium is advancing daily and has covered a large portion of the granuloma; marked general improvement also. February 21, 1921, injection .11 gram. February 22, 1921, injection .12 gram. February 24, 1921, injection .08 gram. Changed from sterile water to normal saline to make the solution, and the pain in the arm and shoulder was not noticed by the patient, in fact she seemed to complain much less all the way through the day, than when the sterile water solution was used. February 26, 1921, injection .05 gram. The inguinal region has entirely healed and the vulva is rapidly approaching the normal once more. Injection .05 gram was given on the following dates: March 3, 8, 10, 12, 15, 23, 26, 29. The total amount of tartrate administered to date, 1.96 grams. The general condition of the patient is extremely good, appetite is excellent, excretions give no trouble, sleeps well, and irritability has disappeared. When she was admitted in November she weighed but 87 pounds; March 8, weight had increased to 99 pounds, and on April 21, a further increase to 106 pounds was registered. She had gained no weight up to the time the administration of tartar emetic was instituted. Three blood Wassermann tests November 11, 1920, December 27, 1920, and February 24, 1921, were all reported negative in all antigens. All urine reports have been normal; catheterized specimens were taken. April 23, 1921, received .10 grams of the drug intravenously, making the thirty-third injection. She has been discharged and will report to the venereal dispensary once weekly for continued treatment. The growth on the vulva and in the inguinal region has entirely disappeared, healing with considerable scarring, the cicatrix being slightly elevated. There are two or three small areas between the vulva and the thigh, and in the region of the fourchette that have not entirely healed, the largest of these is about the size of a dime. Patient followed to date (October, 1921). Has continued treatment as prescribed. No recurrence and has continued to gain in weight and general health.

Case 3. G. J., male, negro, age 37, admitted May 19, 1920, complaining of sore in groin. Born in Virginia. Patient has traveled as a sailor to tropical ports. Seven years ago he had a sore on the foreskin. Several weeks later he developed a right-sided bubo, which was incised and drained. This healed without incident, broke down again 3 weeks later, but healed soon and has remained well since. Present condition started about 6 years ago, when there appeared two small pimples at the hair margin above the pubis and a little to the right of the mid-line. One of these healed up but the other enlarged and finally broke down, discharging some pus and rapidly forming exuberant granulations. This tissue spread throughout the right groin. Two years ago the entire growth was excised. The operative wound healed almost completely, except a small crusted center spot, and under this crust granulations again formed and began to spread. Soon the entire groin was involved and the granuloma extended down to the fold between the scrotum and the thigh on the right side. Six months ago X-ray treatment was begun and the condition has slowly progressed toward healing. February 10, 1921, patient is an employee of the hospital. The right groin and iliac region shows a large tense scar, part of which is devoid of pigment, extending from the symphysis to the iliac bone and measuring about 2½ inches in diameter. At the side of the scrotum the scar passes down the inguinal fold to the perineum, just posterior to the scrotum. At two places in this scar there are unhealed, active, lesions. One near the anterior superior spine, measuring 1 by 1½ inches in size. The granulation tissue over it is not exuberant, but lies flush with the surface of the skin, and is moist. (The effect of X-ray treatment.) The other area lies near the posterior part of the scar, in the fold between the scrotum and the thigh. This shows a sinus about one quarter of an inch deep, admitting only a probe point but discharging pus constantly. The area immediately around this opening is raw and abraded and shows an area of granulations about the size of a dime.

Treatment. On February 11, 12, 14, 15 and 16, 0.05 gram of tartar emetic was given intravenously. After the third injection, the upper lesion became dry and crusted over. The patient suffered some rheumatoid pains about right shoulder joint, painful to motion, but without local symptoms. Some of last injection was spilled into tissues. February 17, 1921, 0.08 gram of tartar emetic intravenously. February 21, 1921, abscess at point of injection where tartar emetic was given extravenously. Same incised. Given 0.08 gram today. February 25, 1921, 0.06 gram given today. Arm healed; upper lesion completely covered with epithelium; lower seems $\frac{1}{16}$ inch in depth and no exudate. On February 26 and 28 and March 2, given 0.06 gram of drug. March 3, 0.07 gram of tartar emetic intravenously. March 4, 0.08 gram of tartar emetic intravenously. March 7 and 8, 0.09 gram of tartar emetic intravenously. March 9, 16, 19, 23, 26, and April 11, 15, and 19 given 0.10 gram of tartar emetic. Patient has been under observation to date (October, 1921) without recurrence.

Case 4. E. C., female, negro, admitted December, 1920, complaining of sores about vulva. Patient born in Virginia and moved in early life to Philadelphia, where she has lived ever since. Present condition started in August, 1918, with profuse vaginal discharge. In September, 1918, first noticed swelling in left groin which reached the size of a hen's egg. In October, 1918, several small pea-sized papules, grayish in color, were noticed upon left labium majorum and on the mons pubis. These itched and on breaking them exuded a watery material. They crusted over, did not heal, coalesced, and resulted in a moss-like, raw mass that bled on the slightest injury. She confesses to coitus 9 days before the development of these pimples. She was admitted to the Philadelphia General Hospital October 23, 1918, found to have Wassermann 1+. Given six injections of arsenobenzol, 14 intramuscular injections

Fig. 5 (at left). Case 1. Condition of patient on January 13, 1921. Groin, prepucial, and perineal involvement. Duration 8 months.

Fig. 6. Case 1. Condition of patient April 23, 1921. Lesions healed in 46 days. Has had 21 injections, total of 1.82 grams of drug. Note that scar tissue in the negro appears white.

of mercury salicylate (1 grain), and potassium iodide up to 150 grains daily and discharged on February 20, 1919, healed but with marked induration of right labium. She remained well for 1 year, but suffered a return of the original vulva sores in October, 1920, and was readmitted to hospital in December, 1920. Lesion described as follows: No evidence of bubo and groins free of disease; an elevated mass of granulation tissue covers the left labium, the mons pubis, and greater portion of right labium. Right labium markedly hypertrophic. The general appearance of the growth is pale red in color, with small bleeding areas at various points; the surface tends to be nodular, is shiny, and presents a moderate amount of moisture. There is no evidence of ulceration, the condition being elevated, proliferative, and with no sign of sloughing at any point. It is firm and gives but slight pain on handling. The lesion extends slightly onto the thighs where touching the enlarged labia. General condition of patient extremely poor, has lost at least 30 pounds in weight, appetite lost, strength gone and confined to bed greater part of time.

Laboratory notes. Section of tissue taken in December, 1920, reported: Chronic inflammatory tissue with areas of degenerated fibrous and epithelial tissue; not tuberculous. December 27, 1920, blood Wassermann test, 3+. December 30, 1920, blood Wassermann test, negative. February 24, 1920, blood Wassermann, negative. January 24, 1920, smears gram stain—gram positive diplococci and large bacilli. Gram negative diplococci and bacilli. Fontana stain—no spirochætæ or spirilla. Giemsa stain—no granuloma bodies. Cultures—diphtheroids and bacillus coli. January 28, 1921, smears—gram stain—gram positive bacilli and diplococci, gram negative bacilli. Giemsa stain—no granuloma bodies or spirochætæ. Cultures—overgrown with bacillus proteus. February 1, 1921, cultures on Sabouraud's medium no growth after 72 hours. February 9, 1921, smears—positive for granuloma bodies; stained with Wright's and Giemsa and showed many intra- and extracellular organisms, diplococci, and encapsulated. February 15, 1921, hæmoglobin, 50 per cent; red blood cells, 3,820,000; white blood cells, 9,200; polymorphonuclears, 46 per cent; lymphocytes, 43 per cent; mononuclears, 4 per cent; transitionals, 5 per cent; eosinophiles, 1 per cent; basophiles, 1 per cent; marked asinocytosis, polychromatophilia, achromia, and poikilocytosis. March 2, 1921, hæmoglobin, 30 per cent; red blood cells, 3,450,000; white blood cells, 5,000; polymorphonuclears, 36 per cent; lymphocytes, 63 per cent (50 per cent large) eosinophiles 1 per cent; polychromatophilia, asinocytosis, stipple cells, occasional normoblast. March 9, 1921, blood platelet count—380,000. March 22, 1921, fragility test: complete hæmolysis, 0.20; complete inhibition—0.46. April 23, 1921, red blood cells—3,380,000; hæmoglobin, 58 per cent.

Treatment. February 11, 1921, gram 0.03 tartar emetic given intravenously. February 12, 1921, 0.04 gram of tartar emetic given intravenously. February 14, 1921, 0.05 gram of tartar emetic intravenously. February 15, 1921, 0.06 gram of tartar emetic intravenously. February 16, 1921, 0.07 gram of tartar emetic intravenously. February 17, 1921, 0.08 gram of tartar emetic intravenously. On February 18, 19, 21, 22, 23, 24, and 26, was given dose of 0.08 gram; on February 28 and March 1, this was increased to 0.10 gram. On March 3, 8, 10, was given 0.08 gram and on March 12, 15, 18, 20, 23, 26, 30, and April 5 and 12, 0.05 gram were given. On April 20, 22, was given 0.06 gram. Total of 1.90 grams administered in 29 doses. Reactions from the drug never amounted to more than local stinging, itching, and throbbing in lesion immediately following injection. No generalized symptoms of toxic effects of drug. The granuloma has almost entirely disappeared except for a very small area in right labium that seems resistant and extremely firm. Healing was fairly rapid, leaving a slightly raised scar and markedly indurated labia. Patient's general condition greatly improved, appetite excellent, sleeps well, works about ward all day and has gained 25 pounds in weight. She is to receive 6 to 8 further injections and then be discharged to Out Patients Department.

Case 5. H. J., male, negro, age 24, admitted February 22, 1920, complaining of a large sore in left groin. Patient was born in Maryland. Lived all his life about Baltimore, Centreville, and Philadelphia, never further south or outside of the country. Onset of the present condition was 3 years ago, when patient developed two small "pimples" on the inner surface of the foreskin. These remained for some time, and gradually increased in size, later breaking down and spreading slowly around the entire foreskin. Several weeks after these "pimples" appeared the glands in both groins began to swell. They receded under iodine treatment, later returned, receded a second time and about 6 months later became large and required incision. Following the drainage the right groin healed. The left, when almost healed, developed "proud flesh" and started to spread down the groin and into the fold between the

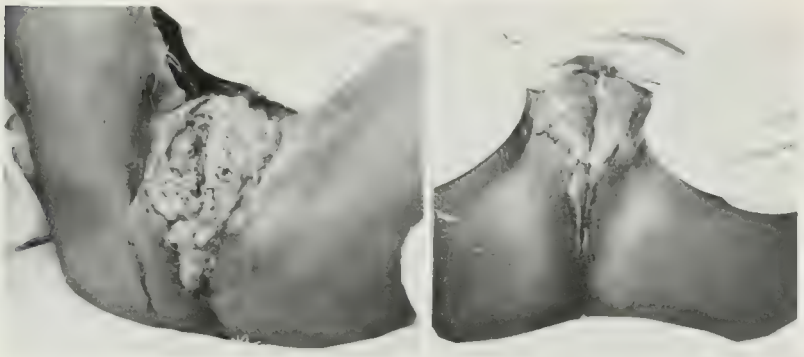

Fig. 7 (at left). Case 2. Pitiable condition of patient on January 28, 1921. Was not expected to live. Duration 3 years and this the third recurrence.

Fig. 8. Case 2. Result of 32 doses, totalling 1.96 grams of tartar emetic. Picture taken April 23, 1921. Lesion entirely healed in 59 days. Some induration remaining. General condition normal. Gained 19 pounds in weight.

thigh and scrotum. Over the perineum and about the anus, "bumps" appeared, which later broke down and coalesced. At present, in the region of the left inguinal glands at the seat of the old scar of a bubo, is a grayish, elevated, granulating mass, extending down between scrotum and inner side of thigh to the perineum, where it spreads to the width of 2 inches in diameter. It is sharply defined and is a constructive growth involving only skin surface, but in the region of the perineum a large ulcer is making its way into deeper tissues. Foreskin is long and can be retracted, and there are several granulating masses, resembling those in the groin, on the mucous membrane of the foreskin. NOTE.—This patient entered the hospital one year ago. He has been receiving X-ray exposures once every 3 weeks. Wound today (February 11, 1921) extends from within 1.5 inches of the left anterior superior spine, downward along the groin and scrotum to the posterior margin of this structure, it crosses the natal cleft, and involves the greater part of the urogenital triangle. The edges are raised and indurated and show evidences of slowly proliferating epithelium. The center of the lesion is moist, oozing, and granulating. The entire process is quite painful, especially at night and when the patient walks he has to assume a stooped position with legs spread widely apart. There is considerable offensive discharge from the surface of the perineal granulations.

Treatment. Given 0.05 gram of tartar emetic on February 11, 12, 14, 15, and 16. There has been a marked decrease in the discharge and the perineal region is covered with dry crusts for the first time in one year. Epithelium is definitely and rapidly growing inward from the edges and several isolated areas are proliferating epithelium at the base of the scrotum. The raised granulations are lower and there is much less pain. Given 0.08 gram dosage on February 17, 18, 21, 22, and 23. He has had some soreness and stiffness in shoulders and back on the mornings after injections, that decreased after being up and about. Epithelium continues to spread inward from all edges, induration is less, exudate decidedly less, and pain progressively decreasing. Given 0.10 gram on Feb-

Fig. 9. Case 3. Old lesion of 6 years duration. Almost healed under persistent X-ray treatment. Picture taken January 13, 1921. Healed in 19 days. Patient has been observed to date (October, 1921) and so far has been without recurrence.

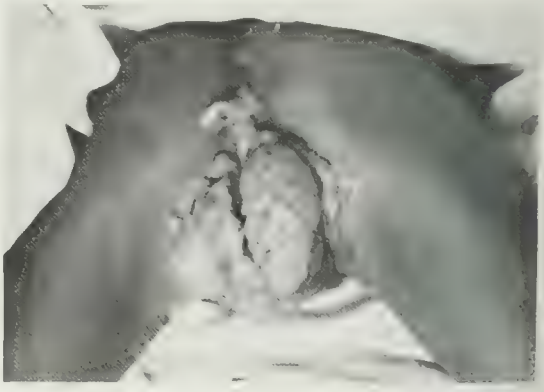

Fig. 10. Case 4. Condition January 28, 1921. This lesion is entirely raw, blood red, with extensions in left groin. Duration 3 years, and this is the third recurrence. Healed on April 23, 1921, after 29 doses of tartar emetic totalling 1.90 grams in 70 days. Labia remained markedly elephantic.

Fig. 11 (at left). Case 5. Condition of patient January 13, 1921. Lesion extending from anterior superior spine to anus. Patient could not walk up stairs. Duration 3 years.

Fig. 12. Case 5. Picture taken March 30, 1921. Lesions healed in 49 days. Has had 23 doses totalling 1.85 grams of tartar emetic. (Scar tissue appearing white.)

ruary 24 and 25. On February 26 was given only 0.06 gram because of persistent bone aches. On February 28 and March 3 dosage of 0.08 gram given. Note on February 27 states that for the past 2 days healing has become accelerated; perineal lesion is now half covered with epithelium; induration is progressively subsiding and patient feels quite well and can walk almost normally. Given 0.09 gram on March 4 and full dosage of 0.10 gram on March 7, 8, 9, 16, 23, 26, 31 and April 11, 15, 19, and 24. April 24, 1921, lesions are completely healed but treatment will be continued. Patient in excellent condition. Discharged today to the pay roll of the hospital as an employee.

Case 6. W. F., male, negro, age 55, admitted February 26, 1921, complaining of growth about anus. Born in Pennsylvania where he has lived all his life. Unmarried and denies venereal disease. Present condition started a little over 2 years ago with slight bleeding, soreness, and distress when at stool. The proliferative growth has increased in size gradually and without recession until the present. There is no pain, soreness, itching or discomfort at present. Occasionally there is slight bleeding from prolonged work (porter) and friction of the parts. Appetite is good, bowels move daily, no loss of weight. On examination, external genitalia and groin are normal. The posterior raphé of the scrotum shows the beginning of a proliferative growth that forms two masses encircling the anus and completely filling the perineum and intergluteal region. The surface is made up of "tubercles" of new-growth, each about the size of a pea and the surface of each is covered with a pearly head of white epithelial tissue. It is painless, and is bathed in a slight serosanguinous secretion. The anal orifice is invisible.

Note.—This patient was admitted to the dermatological ward, where he was given three intravenous injections of neoarsphenamine (gram 0.90). His Wassermann twice taken was negative and no improvement in the local condition was observed. At our suggestion he was given one injection of tartar emetic, 0.05 gram and then transferred to our wards.

Laboratory notes. February 1, 1921, smear from lesion—negative for granuloma bodies. Cultures on Sabouraud's medium negative after 72 hours. February 7, 1921, smear from lesion—granuloma bodies present. No spirochætæ. Various bacteria. Cultures negative for Friedlaender-like bacillus. March 14, 1921, blood count—hæmoglobin, 55 per cent; red blood cells, 4,070,000; white blood cells, 10,800; polymorphonuclear, 71 per cent: lymphocytes, 20 per cent; eosinophiles, 7 per cent; transitionals, 2 per cent.

Histopathology. Section from granulations. Fixation in formalin and Schaudin's solution. Stained with hæmatoxylin and eosin, and Giemsa. Typical of picture described. In addition there was marked proliferation of squamous epithelium in long processes possessing hyperchromatic cells. Section taken from granuloma, February 17, 1921, fixed and stained as above. Structure as above, except that there was no marked proliferation of the squamous epithelium. A few bipolar bacilli seen in endothelial leucocytes.

Treatment. Tartar emetic was given intravenously as follows: 0.05 gram March 2, 1921; 0.06 gram, March 4; 0.07 gram, March 7; 0.08 gram, March 8; 0.09 gram, March 9, with no reaction following injections. This patient has been perfectly tolerant to the rapid increase in dosage. He has not had any symptoms of reaction from the drug at any time. The lesion shows marked and rapid improvement, has decreased in size and especially flattened as though the new-growth was actually absorbing. The raw surfaces deep in the crypts between the proliferated tubercles have less discharge, and epithelization is progressing rapidly. 0.10 gram of drug was administered on the following dates: March 16, 19, 23, 26, 31, and April 11, 15, 19 and 23. April 23, 1921, patient has now received fifteen injections of the tartar emetic. He has shown no reaction to this drug save an almost complete disappearance of his granuloma. There are no raw surfaces remaining and the epithelium is smooth and healthy everywhere. Discharged under promise that he will continue weekly injections in the Out Patient Department.

Note.—Patient returned in September, 1921, with recurrence at ventral edge of anus. Had not kept up his Dispensary Treatment as advised.

Case 7. B. A., male, age 43, admitted February 26, 1921, complaining of recurrent sore on penis. Patient was in hospital last year for the same condition which was relieved by X-ray. Born in South Carolina, but has lived in Philadelphia during the past 20 odd years, and condition developed while a resident of Philadelphia. The lesion appeared for the second time 2 months ago, as a simple "pimple" on the glans penis. This grew in size until as big as a finger nail, when it broke down and became an open sore. There has been no pain, no discharge of pus from it, but a continual oozing of bloody serum. It has increased in size very gradually. It appears as a sharply defined, raw area over glans penis and extending up about

Fig. 13 (at left). Case 6. Lesion limited to anal region and of 2 years duration. Picture taken January 21, 1921.

Fig. 14. Case 6. Result of treatment: Patient has received 20 doses totalling 1.07 grams of tartar emetic. Picture taken May 14, 1921. Healing complete in 37 days.

1 inch on shaft of penis, is not ulcerated, but covered with clean granulation tissue. The mucous membrane is destroyed, leaving a raw, red, oozing surface studded with tiny heads of granulation tissue. It is painless, odorless, and free of discharge.

Laboratory notes. March 1, 1921, Wassermann, negative. Smear positive for typical intracellular organisms. Urine analysis negative. Blood count: hæmoglobin, 82 per cent; red blood cells, 3,950,000; white blood cells, 7,650; polymorphonuclears, 57 per cent; lymphocytes, 36 per cent; mononuclears, 1 per cent; eosinophiles, 4 per cent; basophiles, 2 per cent. March 2, 1921, smears from lesion—positive for granuloma bodies. Cultures, negative for Friedlaender-like bacillus. March 7, 1921, smears from lesion—positive for granuloma bodies. Cultures, negative for Friedlaender-like bacillus. March 11, 1921, smears from lesion—positive for granuloma bodies. Cultures, negative for Friedlaender-like bacillus. Fragility test: complete hæmolysis, 0.28, complete inhibition, 0.40. Blood platelet count, 247,000. March 12, 1921, smears from lesion, positive for granuloma bodies. Cultures negative for Friedlaender-like bacillus. April 4, 1921, smears from lesion, after four injections—negative for granuloma bodies. Cultures—negative for Friedlaender-like bacillus.

Histopathology. Section from margin of lesion taken March 2, 1921. Fixation as outlined and picture typical of original description.

Treatment. Patient was given tartar emetic intravenously 0.05 gram March 23, 1921, 0.06 gram March 25;

Fig. 15. Case 7. Lesion of glans and foreskin only. Duration 2 months but this is a recurrence of a primary attack. Healed in 69 days with 10 doses totalling .85 gram of tartar emetic. Picture taken March 30, 1921, after third injection had been given.

Fig. 16. Case 8. Old lesion of 2 years duration. Almost healed with X-ray. Note double groin involvement and marked induration of foreskin. This induration was greatly reduced by treatment. Picture taken March 30, 1921, after 14 injections of tartar emetic and completely healed. Treatment has been persisted in, and there has been a decided diminution in the heavy induration of the foreskin.

Fig. 17. Case 10. Condition of patient end of February, 1921. Duration one year. Healed in 42 days, having received 17 injections totalling 0.94 gram tartar emetic.

Fig. 18. Case 12. Lesion of glans and foreskin only. Duration 4 years. Healed in 28 days with 8 doses of sodium antimony thioglycollate, totalling 0.68 gram of drug. Picture taken May 11, 1921, before starting treatment.

0.07 gram March 26, and 0.08 gram March 31. Patient has had some rheumatoid pains in shoulders and slight swelling of feet that has made caution necessary with medication. No alarming symptoms, and condition improving rapidly. On April 11, 1921, 0.09 gram of tartar emetic was given intravenously; April 15, 0.10 gram and the same quantity on April 19. Patient has a conjunctivitis and nasal congestion. Injection stopped. Lesion practically healed. On May 9, 23, and 31, 0.10 gram of tartar emetic was injected intravenously. Patient has had ten injections of the drug. Over the lesion on the foreskin a new epithelium has formed entirely; the glans penis is entirely healed except for a narrow sore on the back of the glans about ⅛ inch wide and ¾ inch long; this is dry, level with the remaining surface and apparently on the verge of complete healing. Patient up and about in good condition, wishes his discharge, and agrees to come to the dispensary for further injections.

Case 8. W. H., male, age 39, admitted June 30, 1920, complaining of a sore in groin and inguinal fold. Has been living in Philadelphia for the 2 years prior to the onset of the present condition, which started about December 1918, with a sore on the base of the shaft of the penis. This was pronounced a soft sore and not luetic. It did not heal and about 6 months later the condition broke out in the right groin and has remained as an open lesion ever since. Patient is an unusually fine physical specimen of negro, of almost gigantic development. General physical examination is negative. Genitalia show a raw ulcerated area about the root of the penis and in the right groin extending down to the fold between the scrotum and the thigh. It is raised about the edges and of deep red color, not undermining, and free of discharge or odor. Patient was placed under X-ray treatment for "tuberculosis cutis," receiving exposures every third week. On June 30, 1920, improvement is noted. On August 23, 1920, condition recorded such that he is able to work and patient discharged from the ward to the payroll and put to work in the kitchen.

February 11, 1921. Physically, patient is in excellent condition except for lesions about genitalia. Here there is marked infiltration and scarification of the skin over the base of the penis, resembling elephantiasis. Foreskin is very indurated, hard, and painless; it cannot be retracted. On right inferiolateral aspect about the middle of the shaft is an oblong ulcerated area lying in the middle of a white, indurated, and painless scar. It is 1.5 by 1 centimeter in size, and of a raw, red color. There is a similar, but larger, area on the right side of the scrotum in the inguinal fold; it is moist, bleeds easily on manipulation, flesh is red in color, and is covered with a thin, purulent exudate.

Treatment. On February 11, 12, and 15, 0.05 grams of tartar emetic were given intravenously. Patient says sores are better than at any previous time. Both are covered with a light crust, perfectly dry and epithelium is commencing to proliferate. On February 16, 1921, 0.05 gram of tartar emetic was injected intravenously; on February 17 and 18, 0.08 gram. The lesions are much smaller and induration seems softer. On February 21, 1921, 0.08 gram of tartar emetic was given intravenously. Ulcer on penis healed today. On February 23, 1921, 0.08 gram of tartar emetic was given intravenously and on February 28, 1921, 0.10 gram. Induration of foreskin is rapidly disappearing. The ulcer in groin is scabbed over and apparently healed though not disturbed. Patient has not had any reaction to the medication at any time. Treatment persisted in and on the following dates 0.10 gram of tartar emetic was given: March 2, 3, 4, 7, 8, 9, 16, 19, 31, and on April 11 and 19.

Note.—October, 1921. It is of interest to note that treatment has been so satisfactory to the patient that he persisted in its administration long after he was healed with the result that there has been a marked decrease in the heavy elephantic induration of the skin and foreskin of the penis.

Case 9. W. P., male, age 26, admitted April 28, 1920, complaining of a sore in left groin. In August, 1919, he contracted a sore on the penis and some time after a generalized eruption. In the last 2 weeks he developed enlarged glands in the left groin, which were opened 1 week ago and have been discharging since. There is also a sore on the penis that has been present for the past 4 weeks. With the exception of scars from sinuses and indurated glands of neck, and evidence of infiltration of both apices, general physical examination otherwise negative. There is a phimosis with slight purulent discharge from foreskin. In both inguinal regions are large masses of lymph glands densely matted together, while on the left is a particularly large mass with sinus formation from which pus exudes. Patient was circumcised at this time

Fig. 19.

Fig. 19. Case 14. Picture taken April 12, 1921. Duration 7 months. Patient has received all forms of local antiseptics and dressings, without benefit. Has had repeatedly negative Wassermann tests, but nevertheless, was first given intensive antiluetic treatment during following 3 months and showed no improvement.

Fig. 20.

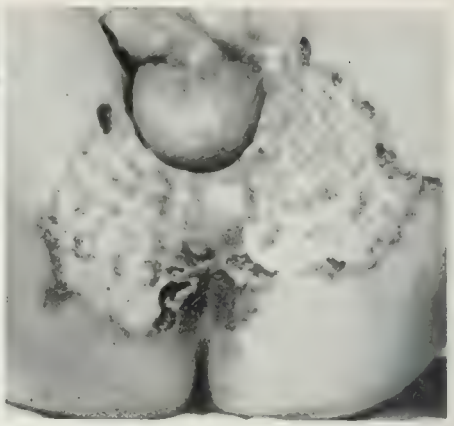

Fig. 20.

Fig. 20. Case 14. Picture taken September 16, 1921, after persistence on tartar emetic injections over 6 weeks. Dose of 0.06 gram was given every 2 days, and he is still undergoing treatment. In all probability he has had a double infection.

(April, 1920) and given 8 doses of neosalvarsan, and on August 24, 1920, he was healed and symptomless (except as noted below) and was then placed on the pay-roll of the Institution.

February 2, 1921: This man is an employee at the firemen's and officers' mess. He has been kept in the institution in order to receive X-ray treatment every 3 weeks, for unhealed condition in groins considered at the time to be tuberculosis cutis. His general physical examination is negative, he is well nourished and developed and apparently in good health. The lesions in the groins have slowly cicatrized with the exception of an ulcer at the base of the scrotum on the right side about the size of a kidney bean, and on the inside of the left thigh, where it comes in contact with the scrotal lesion, are found four raised areas, sharply defined, plateau-like, about 1½ centimeters in size. These latter lesions are covered by very thin epithelium and on two of them where the epithelium has been rubbed off typical granulation tissue is present. Patient states they are new lesions beginning to develop, as others have done before.

Treatment. On February 2 and 12, 1921, 0.05 gram of tartar emetic was injected intravenously; on February 18, and on February 28, 0.10 gram.

April 11, 1921, patient healed so rapidly after above treatment that he neglected his injections. Today there is a recurrence of similar lesions on the thigh. He was given 0.10 gram of tartar emetic intravenously. April 19, 1921, 0.10 gram of tartar emetic intravenously.

NOTE.—This patient is an employee of the hospital. He has persisted in his treatment and has remained perfectly healed to date (October, 1921).

CASE 10. M. W., female, age 20 (from the service of Dr. A. H. Lippincott, Cooper Hospital, Camden, New Jersey), admitted February 8, 1921, presenting extensive lesions about genitalia. Past history unimportant. Present condition of 1 year's duration, commencing as a small nodule on the right labium majorum, which ruptured and then started to proliferate, and has gradually involved the entire vulva and perineum. The rapidity with which this extended varied, but at no time did it show any tendency to heal spontaneously, and patient has not received any medical treatment for the condition. There has been a rather constant, profuse, foul-smelling, and at times blood-tinged discharge. Chest examination showed evidences of pulmonary tuberculosis at both apices. The vulva lesion presents a large, raw mass covering both labia, and extending from the symphysis to the perineum, it follows the labia down into the vagina and extends into the anus posteriorly for about 1.5 inches. Cystoscopic examination is negative. Histological examination was made of section of tissue removed from the right labium. At the same time smears were taken from the area of excised tissue. Microscopic examination showed a marked round-cell infiltration. Polymorphonuclears and a few eosinophiles can be seen. There are some infolding areas of epithelium. No evidence of malignancy. Smears from lesion were positive for granuloma bodies. No cultures were taken. Blood count, hæmoglobin, 69 per cent; red blood cells, 2,100,000; white blood cells, 9,600; polymorphonuclears, 85 per cent; lymphocytes, 10 per cent; large mononuclears, 4 per cent; eosinophiles, 1 per cent.

Treatment. From February 10 to March 7 local treatment with the usual surgical dressings and applications produced no result whatsoever. On March 7, 1921, she was given 0.05 gram of tartar emetic intravenously, and noticed intense burning pain in the lesion immediately after administration, lasting about 10 minutes. On March 9, this dose was repeated and on the 11th and 13th 0.06 gram was given. After this fourth dose, evidences of healing appeared about the edges of the granuloma over the symphysis. Gram 0.06 was given on March 18, 21, 23, 25, 28 and 30, at which time it was seen that the condition, at first slowly healing, was now healing with great speed and rapidly being covered with epithelium. Same dosage was administered on April 2, 4, and 8 when her hæmoglobin was found to be 70 per cent and red blood cells, 3,000,000. Healing still progressed rapidly, and after injection of the same dosage on April 11, 15 and 18, the entire lesion was healed except for a small area to the

right of the anus and a heavy subcutaneous induration of the labia. Patient discharged. To continue treatment in Out Patients Department.

Case 11. G. W., male, negro, age 25, admitted July 13, 1921, complaining of open sore in the right inguinal region. He had a chancre 4 years ago and gonorrhœa 3 years ago. This present condition was preceded by a bubo which broke down spontaneously and then healed. Upon the scar a new lesion appeared which has persisted for three years. Patient in wretched condition and health. Abdominal wall and thighs studded with keloids, scars and abscesses from the use of hypodermic injections. In the right inguinal region is a raw granulating surface typical of the granuloma lesion and 10 by 4 centimeters in extent.

Laboratory notes. July 18, 1921, smears from lesion, positive for granuloma bodies. Cultures, negative for Friedlaender-like bacillus.

Treatment. Tartar emetic was given intravenously as follows: 0.05 gram, July 15, 1921; 0.06 gram, July 17; 0.07 gram July 19; 0.08 gram July 21; 0.09 gram July 23, and on July 25, 27, 29, and 31, 0.10 gram.

Final note. The granuloma is very much improved and is healing along upper edges. Patient insists on being discharged against our wishes. He is a drug addict.

Case 12. E. P., male, age 32, admitted May 5, 1921, complaining of sores on penis of 4 years duration following a slight "hair-cut" in the skin of the frenum. This slowly became sore and inflamed, and at the end of 1 year presented two sores each about the size of a finger-nail. Was given, a year ago, about twelve injections of neoarsphenamine with slight improvement but not complete healing, and during the past 2 months the lesion has shown greater activity and growth.

On examination the foreskin was found swollen, œdematous, and almost covering the glans. On the glans about the meatus and on the mucosa of foreskin on either side from frenum are sharply defined, firm, raw, red, oozing areas with slightly elevated borders. Wassermann reported 2+ and patient given three injections of neoarsphenamine, after which sore reported "drier, no oozing and cleaner, but no closing in of the edges, no islands of skin formation, i. e. no healing."

Laboratory notes. Smear from lesion—positive for granuloma bodies. Culture, negative for Friedlaender-like bacillus. Blood culture, sterile. Blood Wassermann, 2+; cholesterin, 4+; noguchi, 1+. May 7, 1921, smears from lesion, positive for granuloma bodies; cultures, negative for Friedlaender-like bacillus. May 9, 1921, complement fixation using antigens made from organisms from Case 16, Case 14, and Friedlaender-like bacillus from sputum. Results—all negative. Smears from lesion—positive for granuloma bodies. Cultures negative for Friedlander-like bacillus. May 14, 1921, inoculation of patient. Two abraded areas were made on the left arm; one was inoculated with cotton swab saturated with a 24-hour culture of the Friedlaender-like bacillus isolated from Case 16; the other with normal salt as a control. Patient was kept off of specific antimony treatment until May 31, 1921. Observations were last made on June 29, 1921, and up until this time no lesion had resulted. May 26, 1921, smears from lesion, negative for granuloma bodies; culture, negative for Friedlaender-like bacillus.

Histopathology. Section from granulations taken May 6, 1921. Fixed and stained as described. Picture that of original description. Very little proliferation of epithelium from skin. A few intracellular coccoid forms suggest granuloma organisms, minus their capsules. They are seen only in the large mononuclear cells.

Treatment. May 31, 1921, first injection of sodium antimony thioglycollate intravenously — 0.05 gram intravenously; on June 2, 1921, 0.06 gram; on June 6, 1921, 0.07 gram; on June 10, 1921, 0.10 gram; on June 13 and 16, 1921, 0.10 gram; on June 24, 1921, the lesion is healed. One area is covered with superficial scab. On June 24 and 27, 1921, 0.10 gram of tartar emetic was given intravenously. July 1, 1921, lesion is entirely healed. Discharged from ward. To continue weekly injection of tartar emetic in venereal dispensary.

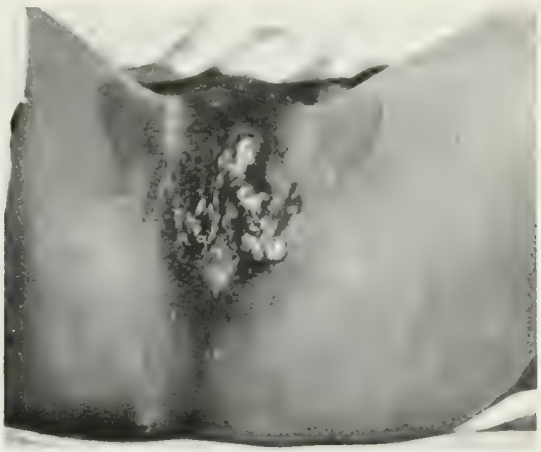

Fig. 21. Case 15. Picture taken January 28, 1921. Duration 6 weeks. Wassermann 4+. Given neoarsphenamine and X-ray exposures for 5 months with only partial healing. Cured with five injections of tartar emetic.

Case 13. D. H., female, admitted May 30, 1921, complaining of genital sores of one year duration, whose onset followed several boils upon the buttocks and started as an itching papule upon the labia majora and spread as a raw, oozing, red surface.

Examination reveals the labia majora as big, hypertrophied, swollen-looking affairs. Beginning with the inner margins, the labia are ulcerated, the ulcerated proliferating mass of tissue taking in both labia majora and minora on both sides and extending from the anterior part of the labia minora to the posterior parts in both sides. This mass is very hard, granular looking, with here and there a white plaque-like looking area. It is red but not bleeding. When touched or rubbed it does not bleed and very little pain is complained of. There is no odor. The mass extends to the entrance of the vagina, and here ends quite abruptly. The vaginal wall is not inflamed but feels quite hard. The cervix is not eroded and the cervical canal is normal. There is very slight discharge. No masses can be felt by vaginal examination. The uterus seems to be slightly posterior. There is no cystocele, rectocele, or vaginal fistulæ.

Laboratory notes. June 1, 1921, a section taken from margin of lesion, fixed, and stained as described, shows typical histological picture of granuloma but no intracellular organisms were found. June 3, 1921, smears from lesion positive for granuloma bacillus. Cultures, negative for Friedlaender-like bacillus. June 13, 1921, smears from lesion positive for granuloma bodies. Cultures, negative for Friedlaender-like bacillus. Some material directly from the lesion put into broth, centrifuged, and the sediment inoculated into animals. Three guinea pigs and a mouse were inoculated subcutaneously. No lesions occurred in any of the animals.

Treatment. Between May 20, 1921, and June 23, 1921, patient was given six (6) intravenous injections of 0.05

Fig. 22. Case 16. Picture taken on admission to Penitentiary, June 29, 1920. Lesion of 10 years' duration. Condition approximately the same when tartar emetic treatment started May 5, 1921. Healed in 45 days after 20 injections of tartar emetic.

gram each of tartar emetic. Between June 25 and July 26 patient was given four (4) injections of 0.08 gram each and three (3) injections of 0.10 gram each of tartar emetic. Between August 1 and August 22 (day of discharge), patient was given seven (7) injections of 0.08 gram each of tartar emetic.

On date of discharge, August 22, condition so thoroughly healed, that she was discharged to Out Patient Department to continue after-treatment. She has been working around the ward for the past month, has no complaint, and has gained in weight.

Case 14. F. D., male, *white*, age 25, admitted December 20, 1920, with excoriated sores about left groin and perineal region. Onset 2 months before with four or five sores on the penis. These primary lesions were soft, painful, and like fever blisters and were followed by an inguinal adenitis which became "ripe" and a doctor opened the abscess. It slowly but completely healed, but shortly after healing multiple sores broke out about the edges of the inguinal scar. These sores have received abundant attention and many local applications but have progressively spread until on admission the lesion extends down the side of the scrotum and thigh, over the perineum, and as far back as the anus and cheeks of the buttocks. Wassermann negative with three antigens; von Pirquet skin test for tuberculosis negative. There was great divergence of opinion among the staff as regards the diagnosis in this, the only white man in whom the granuloma bodies were found. First considered chancroidal, he was given local treatment; next as tuberculosis, X-ray was tried; in April the finding of typical intracellular organisms of granuloma inguinale started him on tartar emetic therapy and when no improvement was noted after eight injections, it was ordered off and a fourth opinion instituted active antisyphilitic treatment which was pushed for 2 months without any apparent improvement. Beginning July 26, 1921, patient has been getting on alternate days intravenous injection of 1 per cent tartar emetic. Started with 5 cubic centimeters and advanced to 10 cubic centimeters then dropped to 6 cubic centimeters per dose. Condition fluctuates. Heals almost and then breaks down anew. Now healed more than ever before and only a periphery of superficial and not particularly inflamed ulcerations left. Patient's general condition excellent.

Note.—This is the only case that we have experienced of infection in the white race. The picture was not typical and our feeling is that a double infection was probably present. He received vigorous antiluetic treatment to no avail in the face of repeatedly negative blood tests. His improvement under antimony has been more marked and permanent than anything during the previous 7 months. Picture shows the amount of improvement, patient at this date under continued antimony treatment. General physical condition has improved very markedly.

Case 15. B. B., female, age 20, admitted December 29, 1920, complaining of sores on genitalia and in groins. Onset 6 weeks before admission, as small papule on right labia. Patient picked this sore and one week later it started to increase in size and has refused to heal. Lesion found to involve left inguinal region, both labia, the right being ulcerated its entire length as likewise the right labia minora with extensions to entrance to vagina. Wassermann 4+ on all three antigens. Patient given two injections of neoarsphenamine and discharged to Out Patients Department where treatment with neoarsphenamine was continued at weekly intervals until June 1, 1921. She likewise received X-ray exposures at 3-week intervals. Readmitted on above date and local condition found somewhat improved, the labia of elephantic size and the lower half of right labium still an open sore.

Laboratory notes. June 3, 1921, smears from lesion, negative for granuloma bodies; cultures, negative for Friedlaender-like bacillus. June 6, 1921, smears from lesion, positive for granuloma bodies; cultures, negative for Friedlander-like bacillus.

Treatment. July 14, 1921, patient has received one (1) injection of 0.05 gram of tartar emetic and four (4) injections of 0.08 gram tartar emetic. Lesion is now entirely healed. Most of the induration has gone and patient is today discharged to Out Patients Department for continuation of treatment.

Case 16. C. B., male, age 43. Patient's first admission was in 1911, suffering with a sore involving foreskin and glans. Eight years before (1903) he had had a similar lesion which healed in 4 weeks and again 3 years before (1908) a second lesion on foreskin at which time he was circumcised and it took 10 months to heal. Present sore developed 1 year after the above second lesion and has had various

treatments during 2 years without any apparent effect toward healing. He remained in the hospital for 1 month and was discharged (on request) unhealed. Readmitted in 1915 with lesion showing destruction of skin and subcuticular tissues over entire penis and extending over upper portions of scrotum, into groins and suprapubically. Received active antiluetic treatment and 8 X-ray exposures. Diagnosed tuberculosis cutis and discharged 7 months later still unhealed. Readmitted in 1916. Penis almost completely destroyed and scrotum markedly swollen. Condition has gradually and continually grown worse. Similar diagnosis and treatment instituted and discharged 3½ months later, with condition somewhat relieved. Readmitted in 1917. Penis completely destroyed. Ulceration extending over right inguinal region and upper portions of scrotum. Received 18 X-ray exposures and discharged 10 months later.

NOTE.—Patient known to be at present an inmate of the penitentiary which he entered on June 29, 1920. Investigation found him to be in about the same condition as at the time of his fourth hospital admission as revealed in the picture taken at the time of his confinement. July 20, 1920, Wassermann test, negative. August 20, 1921, following letter received from Dr. H. Phillips, resident physician, Eastern Penitentiary, Philadelphia, Pennsylvania: "In accordance with your request we submit below data on C. B., a prisoner now confined in the above institution. On May 5, 1921, we commenced intravenous treatment. Injection 5 cubic centimeters, 1 per cent tartar emetic, gradually increasing dose until 10 cubic centimeters was given in each injection. These injections were given every other day for a period of 2 months. After 2 months the treatment was cut down to one injection weekly. After ten treatments were administered he began to heal very rapidly, and was entirely healed after being under treatment for a month and a half. Following is list of treatments as given: May 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31; June 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30; July 2, 4, 7, 14, 21, 28; August 4, last injection. Trusting this will cover the information desired."

Laboratory notes. April 26, 1921, smear from lesion—positive for granuloma bodies; cultures, positive for Friedlaender-like bacillus.

Histopathology. Section from margin of granuloma, fixed and stained as others. Structure typical of granuloma. Large preponderance of endothelial cells. Considerable proliferation of squamous epithelium. Coccoid forms seen in some large mononuclear cells.

HYDATID CYSTS OF THE PANCREAS[1]

BY MANUEL ALBO, M.D., F.A.C.S., MONTEVIDEO, URUGUAY

On connait peu les maladies du pancreas on ne les recherche pas. (Arnozan.)

HYDATID disease of the pancreas is a rare affection. Meisser in 983 cases found none of the pancreas. Feichman, among 2,452 cases found only 3, two of which were taken from the English literature and one from the Russian, making an incidence of only 0.12 per cent. Herrera y Vegas and Cramwell, in 970 cases from 1875 to 1900 mention none of pancreatic localization. Graglietto gives an incidence of 0.12 per 100 as compared with 42 per 100 in the liver.

In 375 cases from the statistics of the hospitals of Montevideo from 1908 to 1912 there were no cases of pancreatic involvement.

Pena gives the following statistics in 150 cases operated upon in the Children's Clinic

LOCATION OF HYDATID CYSTS IN ADULTS
1908 to 1912

	1908	1909	1911	1911	1912
Liver	76	37	13	72	51
Lung	7	14	17	10	11
Kidney	1	4			11
Mesentery	1				1
Ovary	1			1	
Iliac fossa		2			
Multiple of peritoneum		1	7	6	3
Lesser peritoneal cavity		1			
Omentum		1			
Pelvis		1			
Muscular		1	2	3	2
Retrovesical			2		
Submaxillary gland			1		
Thyroid gland			1		
Orbit			1		1
Liver and kidney					1
Spleen					1
Tongue					1
Cystic degeneration of the spleen					1
Vesico-uterine pouch					1

STATISTICS OF THE PREYRA-RUSSELL HOSPITAL
1908 to 1913

Age	3	4	5	6	7	8	9	10	11	12	13	14	
Location													
Liver, only	2	4	1	4	17	3	7	9	11	10	6	1	75
Liver and peritoneal cavity													3
Liver and omentum		1		2		1			1	3			2
Liver and right lung													2
Liver and spleen			1										1
Lung				2	2	1	2	1	3	1	2	3	17
Peritoneal cavity				2					1	2	1	1	7
Brain				1	1		1	1		1	1		6
Neck							1	1	1				3
Total	2	4	2	11	20	5	11	12	17	17	10	5	116

[1] Translation through the kindness of W. R. Meeker, M.D., Rochester, Minnesota.

from 1896 to 1913, 125 of which were operated upon by himself.

Cysts of the liver	100
Cysts of the lung	10
Retrovesical cysts	3
Cysts of the kidney	3
Cysts of the cerebrum	2
Cysts of the spleen	2
Cysts of the neck	2

ETIOLOGY AND PATHOLOGY

Hydatidosis is an affection caused by the tænia echinococcus.[1] The affection is prevalent in countries in which man lives in contact with the dog; Iceland may be mentioned particularly. It also is prevalent in grazing countries and the number of cases seems to increase the longer the cattle raising industry is established. It is thus an important affection in many sections of South America. Cramwell and Herrera Vegas say: "Hydatid cysts were unknown among us until 1870 and it is only from 1890 that they began to be observed with certain frequence, but in the last 10 years they have increased in such an alarming manner that the government has been forced to consider means of combating the disease. . . ."

DESCRIPTION

The head of the tænia echinococcus measures no more than one-third of a millimeter in breadth, is provided with four suckers and a projecting rostellum in which are inserted hooklets of variable dimensions and number. Generally 28 to 50 may be counted. The neck is very short and the body consists of three or four segments at the most, the last segment measuring near 2 millimeters in length and 0.5 millimeters in breadth. The total length is 2.5 to 5 millimeters, being one of the smallest species known.

LARVA

The larvæ are the hydatids or echinococcus (echinococcus polymorphus). They develop in a great number of herbivora particularly in the sheep, and less often in carnivora, in the liver, lungs, and different organs. They are frequently observed in man in which they produce what is called hydatid cysts. The cyst is formed by the tissues of the host surrounding the hydatid in a parasitic manner.

EVOLUTION

The ovum measures 30 to 36μ in diameter and contains a dormant embryo. Ingested by a sheep or man it changes to a vesicle (hydatid) with a wall composed of an external laminated cuticle and an internal germinative or parenchymatous layer. This membrane gives rise to brood capsules, from which scolices are developed. A single ovum may thus give rise to hundreds of adult worms.

The scolices retained by a fragile peduncle may become detached, but are more often invaginated. They frequently disinvaginate and the hooklets return to the exterior. As they perish they fall into the liquid of the broad capsule. The wall of a cyst may become thin and rupture, thus discharging heads or hooklets of tænia echinococcus free in the cystic liquid. These may be detected by microscopic examination after puncture of a cyst.

When a part of the germinative membrane is surrounded by a cuticular lamina, small vesicles are formed which travel toward the exterior as the result of continuous formation of an internal stratum of cuticle. These daughter cysts have the same development as the original and according as they fall by rupture of the cuticular membrane into the mother cyst or outside of it, there may arise endogenous or exogenous daughter cysts.

In all the cases the endogenous daughter cysts differ from the parenchymatous cysts in that the first presents always a stratified cuticle while the endogenous present none at all. Daughter cysts may in turn produce grand-daughter cysts. In certain cases there may be arrest of development of hydatids, the cyst continuing to grow in size, but there are no corresponding production of heads. This produces an acephalic cyst. The hydatid liquid is very toxic.

The third segment has a perfectly developed reproductive apparatus and contains in its interior no less than 500 ova (*Parasitologie humaine*, Neveu-Lemaire).

When the ova are eliminated to the exterior they may be distributed by wind or water and

[1] Tænia Echinococcus Siebold, 1853. (Type, vermes; class, plathelmints, order, cestodes; family tænia, group, tænia vesicula or cystica of Leukart.)

deposited upon vegetables which are eaten by animals and man. They may remain in water which is used for drinking purposes and thus may be consumed directly.

The ova may also be directly transmitted in other ways. The intimacy of men and dogs in many localities is well known, as for example in Uruguay. Here the dog forms an integral part of the family, living in the same habitations, eating from the same plates, constituting for the rustic herdsman his most faithful friend and in the end really his most terrible enemy. The herdsman feeds the dog with the same fork with which he himself eats, often sharing mouthfuls equally. It is clear then that the dog may infect the man directly, if we bear in mind that numerous ova of tænia echinococcus remain adherent to the hairs of the anal region after defæcation and that the dog licks this region frequently in his habits of cleanliness.

The ova once introduced into the digestive apparatus reach the stomach and are mixed with the gastric juice. This dissolves the investing membrane in 4 or 5 hours, according to Leukart, who fed ova to rabbits. The embryo itself is in consequence liberated and mixed with the stomach contents. It is then carried to the duodenum where it makes use of the hooklets with which it is provided, attaching itself to the intestinal mucosa and finally opening up a passage for itself through the intestinal coats. From here it may localize in different regions of the body, preferably in the liver.

What is the route which the embryo follows in this last passage before implanting itself definitely in the organs of the body? In the majority of cases the liberated embryo after having passed through the intestinal walls penetrates to the capillaries and is carried by the portal circulation to the liver where it anchors and gives rise to the most common of hydatid cysts. Leukart's observations have proved many times the existence of embryos in the blood of the portal vein of rabbits infected with ova of tænia echinococcus.

The mode of transmission may also be the portocaval system or by way of the hæmorrhoidal veins which according to some authors is the most frequent.

This manner of infection is certainly the most common and explains why the cysts localize preferably in the liver.

Some authorities are supporters of a direct migration and maintain that the embryos of the intestinal walls pass, by means of the lacteals, to the lymphatic channels and thoracic duct. They are thus emptied into the venous system, making their way to the right heart, pulmonary artery and lung, either anchoring here or being disseminated to other organs. "This manner of infection must, however, not be very frequent as it would not explain why hydatid cysts are so much more common in the liver than in the lung." (P. Belou.)

Contagion by inhalation of dust particles in which dessicated ova of tænia echinococcus may be present is cited by certain Australian physicians (Bird). By this means ova might lodge in the lung and be disseminated from here by vascular embolism. We think this method may be disregarded except for the possibility of contaminating the digestive tract by aspiration of respiratory secretions.

The digestive tract must be admitted the most frequent route of entrance with intermediary of the blood stream for localization in the pancreas. It may be supposed that, because of the anatomic characteristics of the gland having its excretory ducts in connection with the duodenum, there might be a direct migration from the duodenum This method has been supported by Hauser who regards the contamination of the portal system as the less rational method

With regard to this hypothesis of Hauser we may repeat Devé's assertions concerning the migration of the liberated embryo from the intestinal tract to the liver. He maintains that the passage can be directly across the peritoneum or indirectly at the expense of subperitoneal tissue, but that the most probable hypothesis is that the portal vein constitutes the great avenue of entrance of the hydatid parasite to the liver and in a general way to the entire organism.

Exceptionally, he says that a certain quantity of embryos may be carried to the liver by the arterial route, as for example by the cœliac trunk in the case of an echinococcus

septicæmia following the massive infection of the blood stream by rupture of a cyst. Although the development of the liberated embryo has not been studied experimentally for the pancreas we must deduce from the probable origin that it would not be in the interior of the glandular acini, but in the periacinar vascular network in which the parasite would most likely be detained. During its progressive growth the encasing cuticle is developed as the result of a local reaction in which the surrounding vascular tissue and migratory elements participate, the parenchymatous cells disappearing entirely as the result of toxic necrosis and mechanical pressure in the region of the parasite (Devé, loc. cit.). The permeability of the glandular duct is, however, conserved as the duct epithelium persists in spite of compression. This would indicate that glandular function would be restored with removal of the parasitic process.

In which direction do cysts of the pancreas usually develop? In the direction in which they encounter least resistance, and in this way the cyst may project into the lesser omentum, below the transverse mesocolon, or into the gastrocolic ligament. Attention must be called to the fact that the direction of greatest growth of the cyst does not indicate a superficial location in the pancreatic parenchyma at that point, as the gland itself may be pushed forward by the growing cyst.

PATHOLOGICAL ANATOMY

The development of the parasite within the gland provokes reaction in the surrounding tissue resulting in the formation of a fibrous envelop usually of finer texture than that which develops in the lung and liver. There are, according to Chutro, no signs of sclerosis or congestion of glandular tissue to microscopic examination. Even though such changes might be produced they are certainly not marked, so that no deficit of glandular function is felt except in those cases in which there is compression of the ducts. On the other hand, when the tumor is implanted in the gland in a superficial position, its position becomes subserous and the vascularity of the omenta and mesenteries is increased often to an extent that would make its extirpation seem dangerous to most surgeons. There is often retraction of the lesser omentum and adhesions to the stomach, colon, and liver. Adhesions to the abdominal wall are found only in the last stages of development.

Cysts developing in the cervicocorporeal portion of the pancreas usually have one of three points of prominence: (1) across the lesser omentum, (2) across the gastrocolic ligament, (3) across the transverse mesocolon.

Cysts, developing in the tail of the pancreas, usually force forward the stomach and sometimes the transverse colon and often appear at first sight to be below the kidney.

The hydatid cyst continues growing until evident tumefaction is produced in most cases. In other cases the phenomena of canalicular compression (Wirsung and Santorini) play a more important part. These trains of symptoms are largely dependent upon the position. Hydatids situated in the head of the pancreas and in front of the ducts cause compression very late, while those located within the ducts or behind the duct of Wirsung produce phenomena of compression very early.

COMPLICATIONS

Suppuration has been shown in some observations. Biliary and pancreatic retention with the resulting complex of symptoms may be admitted as the rule with certain cysts. Spontaneous rupture has not been observed. There have been no cases of rupture into the digestive tract reported in the literature.

SYMPTOMATOLOGY

We divide hydatid cysts of the pancreas into three groups according to the pathological anatomy, as follows:

1. Those which develop in a latent or almost latent manner so that they give a symptomatology of palpable or appreciable tumor;

2. Those which develop rapidly producing symptoms resembling those of cancer of the bile ducts or head of the pancreas;

3. Those that produce symptoms resembling those of retroperitoneal tumors.

Those developing in a latent manner with symptomatology of palpable tumor usually produce the same symptom as those of blood cysts of the pancreas. There may be light pains in the epigastrium from irritation of the cœliac plexus, due to the size of the tumor rather than the cystic formation *per se*. The oppression in the epigastrium may at times be of a spasmodic form due to the same cause. There may be accompanying inaptitude, nausea, and vomiting. Intestinal symptoms may be constipation from compression of the colon, a viscid diarrhœa called "flux," a greasy diarrhœa signifying pancreatic insufficiency which would be in relation to the extent of glandular destruction. Pancreatic salivation is exceedingly rare (Ludolph and Zielstorff), but it should be kept in mind. The slow pulse would seem to be dependent upon a vagal stimulation. Cachexia is far from frequent (functional deficit) the same as the diabetic syndrome. There is often a transmitted pulse.

We were not acquainted with Navarro's sign (dimunition in the number of pulsations by compression of the pancreatic area) when these patients came under observation so that we did not look for it. The phenomena of compression of the duodenal arc may produce the syndrome of chronic obstruction in this organ with its symptom-complex (vomiting, malnutrition), and it is possible that it may have passed unappreciated in the greater part of the cases operated upon, this syndrome being attributed to mechanical reflexes. The tumor is often perceptible to inspection appearing in the epigastrium when located in the head, in the same region or nearer the umbilicus when located in the body, and in the hypochondrium and flank when located in the tail. The point of greatest prominence is variable, but these tumors follow in general the scheme of Korté and Mayo-Robson already mentioned under pathological anatomy.

Cysts of the head of the pancreas, simulating a cancer of the bile ducts or head of the pancreas, give the following symptoms: (1) general emaciation; (2) bronze color of the skin; (3) icterus most always persistent and progressive with a dilated gall bladder (Courvoisier-Terrier law), with the accompanying discoloration of the fæces, and icteric tinted skin, mucosæ, and urine; (4) pain in the pancreatic area; (5) aversion to fats and oils; (6) pain radiated to the back and left lumbar region; (7) tumefaction, not always palpable even in cachectic subjects (as in one of our cases).

Cysts which develop as retroperitoneal tumors are usually without symptoms except the pain and marked tumefaction when it exists, features which have caused confusion with tumors of the kidney and adrenal.

DIAGNOSIS

Is tumor present? If the answer is affirmative, is it of the pancreas? The question is settled in the following manner.

Determine first whether the tumor is parietal or intra-abdominal. Augagneur has stated that in dealing with an abdominal tumor the first step should be the elimination of tumors of the abdominal wall. Palpation is usually sufficient to do this. A number of diagnostic procedures, however, enable one to decide this point with certainty. If the tumor is mobile or relatively so but becomes fixed when the patient contracts the abdominal muscles, it indicates that the tumor is of the abdominal wall (elevation of the head).

Tillaux preferred the following procedure. The most prominent point of the tumor is marked with a dermographic pencil, and the patient is instructed to inhale and exhale using force in the procedure. If the tumor is of the abdominal wall the most prominent part of the tumor and the skin marking remain in the same relation to each other; on the other hand if the tumor is intra-abdominal, the relations change.

To determine whether the tumor is intraperitoneal or retroperitoneal the same author reasons as follows: Intraperitoneal tumors usually displace the intestinal loops coming in contact with the abdominal wall. The retroperitoneal ones are usually covered by loops of intestine, stomach or colon, so that resonance in front of the tumor will be pathognomonic of retroperitoneal tumors and vice versa, according to Spencer-Wells. Then it has been established that the tumor is retroperitoneal, it remains to determine whether

the tumor developed from the kidney, the mesentery, or the pancreas. If from the mesentery, as a rule it has a median location, umbilical, with intestinal loops in front and immobile laterally. If from the kidney, the location will not be median but lateral and covered by colon; it usually gives increased lumbar dullness and is immobile transversely. If from the pancreas, its location will be median except when located in the tail. It is almost, but not entirely immobile. Le Dentú has assigned great value to a hydro-aerial sound perceived in front of the tumor, really a sign of little value if we remember the possibility of spontaneous hydropneumatic cysts, or those arising from communication with a hollow viscus. More value should be accorded the method of Minkowsky and Nauyn, which consists of the following: (1) accurate determination of the site of the tumor; (2) gaseous distention of the stomach with citric acid and sodium bicarbonate, with a new observation of the tumor which should have been displaced downward; (3) the gas is next released from the stomach by means of a Faucher's sound; (4) an intestinal enema of 2 liters of water is given, noting the new displacement of the tumor somewhat upward.

If, as Chutro believes, it is possible to diagnose hydatid disease of the pancreas, we must admit that the diagnosis without doubt carries a high percentage of error in view of the rarity of the affection. There is neither an eosinophilia nor deviation of complement (Bordet, Geangou, Wassermann reaction), as constant findings to aid in the diagnosis. The résumé of cases to date with the exception of those of Chutro shows that diagnosis has not been made except at operation or autopsy. The symptoms cited by Chutro are not peculiar to this affection but are common to any tumor of the head of the pancreas. We give herewith the basis of diagnosis formulated by this author:

1. Spontaneous pain in the abdomen near the umbilicus and a sense of pressure following a transverse direction in the epigastrium and extending to the hypochondrium;

2. Gastric disturbances of reflex origin from compression without any organic lesion to account for the symptoms;

3. Obstructive icterus which is not modified during a year by medical management;

4. An enlarged gall bladder, which would indicate a tumor at the head of the pancreas (Courvoisier and Terrier).

5. Aversion for fats, and above all the elimination of all fatty substances, without having undergone any digestive changes;

6. Rapid and pronounced emaciation with great loss of strength;

7. The finding of a deeply situated tumor behind the stomach, globular and smooth, and in the region of the head of the pancreas;

8. Completely benign character and gradual development;

9. History of individual residing or having recently come from a country in which echinococcus disease is common;

10. The fact that cysts of the inferior surface of the liver often give signs of compression of the bile ducts, but rarely of the duct of Wirsung;

11. No deformity of liver.

The diagnosis is thus arrived at by a process of exclusion. In case of doubt prolonged icterus is sufficient cause for surgical intervention.

Differential diagnosis should include cysts of the lower surface of the liver and tumors of the spleen and kidney distinguishing features of which have already been mentioned. Important points are the relation to respiratory movements and location with respect to the stomach and colon. Radiography is also important in diagnosis, a previous pneumoperitoneum often permitting identification of the pancreas.

TREATMENT

No satisfactory antiparasitic drug is known. "606" and "914" which have been recommended by some authorities seem to possess no particular value.

In operating, the incision should be so made that it will give the easiest delivery of the tumor; median or lateral according to the particular case. The Bevan incision applied to the left side as proposed by Mayo and Balfour for extirpation of the spleen would be indicated in a cyst of the tail of the pancreas. Recognition of the tumor is not always easy. In our case, in which the greater amount of glandular parenchyma was in front of the cyst, the

impression from palpating the tumor was that of a growth situated at the head of the pancreas. The site of implantation is not always easy to discover when the tumor projects markedly across the lesser or greater omentum or the transverse mesocolon. It is stated that many hydatid cysts of the pancreas are not recognized as such, and that they are merely conceded reactions due to proximity to the pancreas (bordering the gastrocolic omentum, spleen, and so forth). On the basis of location it is convenient to divide them into intraparenchymatous and subserous cysts with sessile implantation. Removal of the tail of the pancreas through the gastrocolic omentum (Lardenois and Okincick) may have its indications. Mobilization of the head of the pancreas (Wiart Sencertt) is suitable for all cysts of the head which permit their delivery, such as those which are situated on the posterior portion of the pancreas and those projecting anteriorly. An ample protection of the peritoneum must be afforded in view of a possible dissemination of hydatids.

Extirpation of the tumor is usually not advisable. This was tried in Graglietto's case, but it is not certain whether this tumor was of true pancreatic implantation. It was a case of pedunculated hydatid whose origin was not certainly pancreatic. With cysts of true glandular implantation extirpations have been practiced only on a part of the pericystic tissue.

Evacuating puncture with the appropriate trocar (Potain trocar for small cysts, and the ordinary ovarian cyst trocar for those of great volume) should be followed by the injection of parasiticidal liquid. We employ a solution of pure formaldehyde 2 per cent in water, or the injection of pure formaldehyde with a Pravast needle and syringe in a quantity proportional to the volume of the cyst. After the proligerous membrane and daughter cysts have been removed, one should proceed to dry the cavity with gauzes soaked in ether, containing some antiseptic substance after the method of Devé. Should the cavity be closed, or drainage practiced? In our experience, it is best to close the cysts if the content is clear, unless the cyst is very large or in case it is necessary to resect the pericystic tissue followed by hæmostatic closure.

To prevent a possible hydatid intoxication, which happens more frequently than most authors will admit, we inject 1 cubic centimeter of 1:1000 synthetic adrenalin (Parke Davis and Co.) during operation also during the following days if tachycardia and dyspnœa accompanied by oliguria persist. The action of this drug in the prevention shock has been well demonstrated in other abdominal operations. Professor Delbet first recommended its use many years ago.

If marsupialization of the pericystic pouch is done it is an easy matter to drain by aspiration as would be done in pleural empyema. Discontinuous instillation of Carrel's fluid should be employed if the microbic conditions of the infection indicate it.

As complementary operations cholecystostomy may be indicated when icterus is very pronounced and there are indications for rapid drainage of bile. There may be indications for gastro-enterostomy in cases of duodenal compression.

The feature in which medical men should become especially interested is that of prophylaxis. This is especially difficult to practice in country districts where there is usually mediocre intelligence and general disregard of advice along scientific lines.

A decrease in the number of dogs on the ranches is of aid. The periodic administration of vermifuges such as calomel and kawakawa to the dogs produces a condition of lowered contagion. The incineration of the carcasses of sheep in which cysts are found, keeping dogs and hogs away from them should be practiced and especial care should be exercised in order that the water supply does not become contaminated. Thorough cooking of all greens which may possibly be infected is recommended. The exclusion of dogs from the living quarters of the family would greatly reduce the incidence of the disease, especially in children.

CASES FROM THE LITERATURE

Cases autopsied. The older cases are of but little importance and they are mentioned only in a general way without laying great stress upon their location and relations. Such cases as those cited

by Montaux and Portal seem to be cases of implantation external to the pancreas with which they were only in contact.

Masseron (thesis upon multiple cysts of the abdomen, Paris, 1881) cites three cases. Two were taken from Turner and Hunter and are of questionable location in contrast to one taken from Meissner which seemed to be an intraglandular cyst. Engel refers to an autopsy of a case of multiple hydatidosis, brain, kidney, and so forth, in which there was also a preglandular pancreatic cyst. The second case of Claessen was undoubtedly glandular and Seidel gives one of the tail of the pancreas.

Thomas. Statistics of cases of echinococcus observed during 10 years, 1868 to 1877, shows only two of hydatid cysts of the pancreas.

Nadashdin gives 0.3 per cent as the result of numerous statistics.

The protocol of Hauser upon the necropsy may be taken as a model of precision and is given herewith.

Carlos B., age 61, caretaker of sheep in Hunter B (North of Mecklenburg) died August 15, 1911. The patient entered the University Hospital, surgical service, April 27, 1911, complaining of urinary retention, cystitis and tumor (abscess?) of the prostate. The illness had begun with intermittent fever and had continued from a carbuncle of the back. The patient was transferred to the ophthalmological clinic on May 31, 1911, because of an iritis. While there the prostatic abscess must have perforated spontaneously. On June 15, 1911, after the iritis had cleared up, he was again transferred to the surgical section. While here a fluctuating abscess developed in the muscles of the left arm. A pneumonia became associated with this. A left pleural effusion was punctured twice showing a very septic and degenerating content. His general condition grew progressively worse finally ending in death on August 15, 1911. Interrelated with these symptoms were certain stomach complaints. An examination of the stomach contents after a test meal showed the following results on July 30, 1911: neutral reaction, no free hydrochloric acid, negative lactic acid, and no evidences of stagnation. There was no palpable epigastric tumor. Clinical diagnosis was as follows: septic pneumonia and bilateral pleuritis. Multiple disseminated abscesses. Prostatic abscess. Cystitis. Suspect cancer of the stomach. The autopsy essentially confirmed the clinical findings. No tumor of the stomach was found. Anatomic diagnosis was as follows: sepsis, septic tumor of the spleen, bilateral perinephritic abscesses, renal abscesses, cystitis, and prostatic abscess. A pleural empyema was found on the inferior part of the left side with extensive pleural adhesions. Hypostatic pneumonia on both sides. Echinococcus cyst of the tail of the pancreas. Staphylococcus pyogenes was cultivated from the blood and from the spleen. The following extracts from the protocol are related more particularly to the pancreatic cyst.

Upon opening the abdominal cavity a pronounced distention was noted. The veins of the greater omentum, and left gastro-epiploic vein were very prominent as from obstruction. These phenomena were found to be due to the presence of a deep tumor not visible *in situ* but evident to palpation. The lesser peritoneal cavity was entered by incising the gastrocolic omentum. From the posterior wall of this cavity the tumor was seen limited above by the stomach, below by the transverse colon on the left by the spleen and gastrosplenic omentum, and on the right by the duodenum and liver. The pancreas seemed to be divided, but in the tail, covered by peritoneum, was the tumor. While *in situ* it was plainly seen that the splenic vessels were intimately adherent to the tumor though not markedly distended. The tumor itself reached to the hilus of the spleen to which it adhered by a ligament (pancreatic-splenic). The specimen was freed from its coverings and the organs surrounding it was removed. The head and body of the pancreas showed no particular changes. The relations with the duodenum were the same as normal. The length of the gland including the cyst was 17 centimeters, a figure which corresponds to the average normal established by Henle and Sappey.

To external measurement the pancreatic tissue measured 11 centimeters and the remainder was tumor tissue. It is, therefore, easily established that the cyst was not adherent to a prolongation but that its location corresponded definitely to glandular substance. Confirming this opinion is the fact that the tumor adhered directly to pancreatic tissue and moreover that it occupied the space included between the visible termination of the pancreas and hilus of the spleen, that which is ordinarily the situation of the tail of the pancreas.

There was a progressive change from glandular tissue to tumor. The specimen demonstrates nicely the gradual thinning out of pancreatic tissue, which disappears without any precise limit on the surface of the tumor. The cyst itself is pear-shaped, measures 6 by 9 centimeters, and is adherent laterally and superiorly to the pancreas. The axis of the pancreas forms an angle of 120 degrees with that of the tumor. The cyst, therefore, faces downward and to the left. The tumor is smooth with the exception of a few small concretions of white color and flucutuating to pressure. Upon incision of the posterior wall a clear, watery liquid escaped in which two daughter cysts the size of cherries were recognized. Sections show clearly that the sac is filled with daughter cysts of variable sizes, in part freely floating, and in part adherent in the form of clusters. The thickness of the cyst wall varies from 1.5 to 2 millimeters.

The specimen was given to the Institute so that further pathological studies were not made.

In none of the other organs were hydatid cysts present. We are dealing in this case, therefore, with a solitary echinococcus unilocular cyst of the tail of the pancreas.

OPERATIVE CASES

Author's personal case. Sinforoso Barcia, an oriental, age 23, single, of Department Florida Villa Vieja, entered Maciel Hospital April 1, 1914.

Three years ago he began to suffer pain in the right side of the abdomen. The pain radiated to the shoulder, and was accompanied by gastric disturbances which began with a marked aversion to fats, later including certain other articles of diet, such as milk. He had never vomited. Constipation was present at this time and became more marked under a régime of soft diet. These disturbances continued for a year in which icterus appeared increasing progressively in intensity until the skin became an olive tint which persisted until the end. It persisted for 2 years in spite of medical treatment and consultation. There was a loss in weight of 20 to 30 kilos. Physical examination showed marked icterus of the skin, mucous membranes, and scleræ, with severe generalized pruritis, apathy, and bradycardia. There was no temperature. The liver was somewhat enlarged but not tender and did not show any tumefaction. The pancreaticobiliary zone of Desjardins was painful, but there was no appreciable tumefaction at this site. There was increased frequency, the urine being loaded with bile pigments. Fæces were entirely colorless. Urotropin, Vichy water and milk were given. Three days before operation he was given 2 grains of calcium chloride, purged with calomel, and lavage on each of the three days preceding operation.

Operation. Anæsthesia of pantopon and ether without incident. A Sprengel incision with abdominal exploration revealed a tumor in the upper abdomen and behind the stomach when the duodenum was lifted. The liver was a little enlarged, darkly discolored, with an enlarged gall bladder which, to palpation, appeared to contain foreign bodies. The greatest dilatation was in the central part where there was a fibrous appearing zone.

Appendectomy, aseptization of the stump with iodine and invagination.

To examine the tumor it was necessary to mobilize the doudenum. It was then possible to appreciate the fact that the tumor formed a part of the head of the pancreas. Puncture made across the parenchyma of the gland on the anterior aspect with a Pravast needle gave a clear watery liquid. Examining the posterior surface, a prominent part of the cyst was found in contact with the duodenum. The cyst was punctured with a Potain trocar and the cystic fluid evacuated. The sac was further opened and the proligerous membrane, which was about the size of an orange, extirpated. The cystic cavity and regional peritoneum was washed with ether. The fibrous capsule was sutured, cholecystostomy performed, and the abdominal incision closed with catgut and silk in two layers.

Postoperative. In spite of the employment of stimulating injections of physiological saline and camphorated oil the pulse as well as the general condition did not improve. As would be expected the gall-bladder drainage gave an abundance of bile. The temperature was 38°C. the pulse between 120 and 130 per minute, auscultation showed râles in both bases, and there was a cough and difficult expectoration. The scant urine in the first few days increased to a liter or more later on. Stitches were removed on the eighth day and the same night there was an evisceration of intestines through the wound as a consequence of the severe cough. The intestines were restored and the abdominal wall sutured in one plane with silver wire. Murphy drip was given, the patient placed in the Fowler position, and camphorated oil given. The temperature continued, high emaciation, and general condition became worse and the patient died on the eighteenth day after operation. Autopsy could not be obtained.

Case of Dr. Mondino (not reported).

Elcira Chodio de Robaina, age 30, native of Uruguay (Department of Maldonada) entered the sanitarium, January 29, 1920. Upon inspection a globular tumor, about the size of a big orange, was seen in the left flank. The tumor was deeply fluctuating to pressure. It was dull to percussion and the dullness was continuous with that of the liver. There was a distinct resonance between this organ and the spleen which did not follow respiratory movements. Hydatid fremitus was not present. The general condition of the patient was excellent, complaining only of a pain in the back radiated to the lumbar region.

Clinical diagnosis. Hydatid cyst of the spleen.

Operation. On January 30, a pararectus incision was made, reaching to the spleen. After incising the external ligaments and peritoneum and entering the abdominal cavity it was noticed that the tumor was in contact with the spleen but that it was not a part of this organ, being luxated somewhat toward the outside. It was thus seen that the tumor was within the lesser peritoneal cavity. On incising the lesser omentum, glandular tissue was encountered which was identified as pancreas. This was protected with compresses and the tumor punctured. Scarcely had the needle penetrated, some 5 millimeters, when hydatid liquid was obtained and the entire cyst was emptied by aspiration. The germinative membrane was incised and extracted, followed by a discharge of yellowish fluid which was collected for further examination. A section of the glandular tissue was also removed for examination. By digital palpation of the cavity, the cyst was recognized as one of the tail of the pancreas, and that its position was intraglandular. The cavity of the cyst was sutured and left in place.

On February 8, the patient was discharged completely recovered. A letter received 6 months later stated that a smaller tumor had recurred at the old site and later completely disappeared.

Dr. Pedro Chutro, surgeon of the Teodora Alvarez Hospital. Hydatid cyst of the pancreas.

Benjamin M., age 26, entered the surgical service of the San Roque Hospital May 24, 1906. The family history was unimportant. In infancy patient had measles and transient gastro-intestinal disturbances. No history of syphilis, malaria, tuberculosis, or alcoholism.

For a year he has enjoyed good health, but in this period and without known cause he began to be bothered with repeated vomiting accompanied by acid eructations which usually occurred a short time after meals. At the same time he had acute pains in the right hypochondrium irregularly intermittent and not radiating. He consulted a physician and in spite of the treatment prescribed he grew worse. He vomited bilious material of mornings and sometimes during the day.

At the end of a month he began to notice an icteric tint to the scleræ and discoloration of the fæces. He was treated as a case of catarrhal jaundice but in 15 days he was so debilitated he could not leave his bed. Icterus also increased in intensity, the skin becoming a dark olive color. The urine was almost green and the fæces the color of plaster and very hard. Pruritis was so intense he could not sleep.

For 4 months he traveled from one hospital to another having tried several varieties of medical treatment, with no results. He continued to lose rapidly in weight, and assimilation of food was almost nil. At this point is recounted a feature of great diagnostic importance.

He stated that he was ordered to take 100 grams of olive oil daily which he did for 3 months. At times the oil was eliminated in the fæces in the same condition as it was when ingested, without having undergone any transformation whatever. More frequently it was excreted in the form of globules of variable sizes as large as that of a nut, greenish yellow in color, of gelatinous consistency and breaking up under the least pressure allowing the oily content to escape. They resembled in all respects the capsules of castor oil now in current use.

After a long period in bed in dorsal decubitus posture his digestive troubles improved. His fæces became somewhat colored and the intensity of the icterus diminished, although it never entirely disappeared whether in bed or up and about. All symptoms recurred later and were accentuated. This led many diagnosticians to believe that the patient had a calculus, with a certain amount of mobility and lodged in the common bile duct.

The patient had also a degree of neurasthenia, and having tired of medical treatment insisted that he be operated upon at once. Temperature 37.2°C. Pulse regular, somewhat tense, and rather frequent, 98 per minute.

Patient was a young man, well developed, but emaciated and wasted. An icteric tint was very marked on the mucous membranes and skin, the latter showing erosions produced by scratching because of the intense pruritis. The left side of the thorax was normal. On the right side there was a moderate elevation in tone. Auscultation revealed the presence of a few râles at the bases. The hepaticopulmonary boundary came to the fourth rib and presented no irregularity. On the right side the inferior part of the thorax was more voluminous. The greater elevation of the costal margin and bulging of the intercostal spaces was clearly perceived.

The liver was 8 centimeters below the costal margin. It was uniformly enlarged conforming to the normal configuration of the liver. The margins were sharp, regular, and distinctly palpable. It was somewhat tender to pressure and followed the respiratory movements. In the incisura of the liver also in apposition with the inferior surface of the liver was a tumor the size of an orange, globular, smooth, somewhat movable, painless, and soft in consistency which together with the location was thought to be a distended gall bladder. To palpation it gave the sensation of a rubber ball, and it could be distinguished as independent of the right kidney the inferior pole of which it touched. To digital palpation of the right epigastrium, the impression of a tumor was obtained, the limits of which it was impossible to estimate because of the tension of the abdominal wall, but it did not appear larger than the size of a fist.

Superficial percussion gave resonance in all this region, but deep percussion demonstrated a zone of dullness in the center surrounded by a tympanitic zone. The dullness was located in the epigastrium, and was independent of the liver from which it was separated by a border of very clear resonance.

Under anæsthesia it was found that the tumor was entirely globular and about double the size of that which was evident to palpation before. It now seemed a little independent of the liver, was somewhat movable, but independent of respiratory movements. The spleen was a little enlarged.

The urine contained a great quantity of biliary pigment and vestiges of albumin and glucose.

Examination of the fæces showed that pancreatic juice had not entered the intestines and microscopically it may be said that the fats had not undergone any specific digestive action.

Diagnosis: On the basis of the above data we concluded that a tumor was present, which, from its evolution and character, should be a hydatid cyst compressing the ampulla of Vater and the location of which should be the head of the pancreas.

Operation. May 25, a short time before operation, patient was given an injection of a liter of physiological saline. Incision was made somewhat to the right of the linea alba reaching from the costal margin to the level of the umbilicus. Opening the abdomen the liver was seen to be congested, and greatly increased in size but not distorted in shape. Externally the gall bladder appeared normal although the fluid contained was under great tension, and the organ had dilated to a point four or five times the normal size. It evacuated its contents slowly by external pressure. Upon examina-

tion of the biliary passages attention was called to the retraction of the gastrohepatic omentum and the presence of a tumor behind the duodenum in the lesser omental cavity independent of the liver. A small puncture yielded clear watery liquid. The gall bladder was so greatly distended that it was a great obstacle to work in this region so that instead of making an evacuating puncture and then mobilizing the intestine to reach the tumor we preferred to approach it in another manner. We therefore temporarily abandoned the first incision and made a median supra-umbilical laparotomy incision. Behind the gastrohepatic omentum the tumor was recognized. It had developed in the head of the pancreas. It was incised with a bistoury letting escape more than a liter of hydatid fluid in which were countless daughter cysts. The membranes were extracted and the cyst cleaned as well as possible. As the cyst walls were very thin and impossible to bring to the border of the wound for marsupialization, drainage was performed by means of gauze and a glass tube packing the cavity to the bottom, passing between stomach and liver. The first laparotomy wound was closed in three layers. In the second a space for drainage had to be left open. Hypodermoclysis of a liter of saline was given. During night patient complained of great pain, but the following two days were passed uneventfully.

During the night of May 28 he had the first bowel movement of colored fæces thus demonstrating the patency of the pancreaticobiliary passages. He seemed markedly improved; upon removing gauze pack a quantity of daughter cysts were discharged. June 1 daughter cysts were being discharged daily. Fæces were well colored. The intense coloring of the skin was gradually disappearing. After having had no appetite for over a year the patient asked for food and was given meat and milk.

June 4, a slight icteric tint was just discernible in the scleræ, while on the skin it was still marked. The cyst continued reducing its capacity and day by day fewer daughter cysts were discharged. Marked improvement in assimilation of food and nutrition and the general condition was daily improving. All sutures were removed.

July 2, all traces of icterus had disappeared. Cysts had ceased discharging, and the drainage tract was growing smaller in size. At the end of October, the patient left the hospital entirely recovered. He had gained 14 kilos in weight.

In May, 1908, he returned for observation with a small eventration which is common in marsupializations. The scar was excised and the abdomen closed in three layers. Viscera in perfect condition.

Virgilio Gragietto. Echinococcus cyst of head of pancreas. Clinica Chirurgica, 1913, p. 786.

Antonia D., age 36, married, entered the surgical section July 31, 1911, with diagnosis of abdominal tumor. She had never been ill, menstruation had been regular until 2½ months ago when it ceased. She had had nine normal deliveries at term. During the past 3 months she had observed that the abdomen was increasing in size, and she could palpate the tumor through the abdominal wall. It did not cause her any pain or trouble of any sort. She was worried only by the progressive increase in size of the abdomen. The patient was a thin woman, poorly nourished, and very pallid. Temperature was normal, pulse full and rhythmic, rate 72 pulsations per minute. Cardiac borders were normal, tones were clear, and lungs negative.

The abdominal wall was flabby, quite thin, with diastasis of the recti muscles so that palpation of the abdominal organs was greatly facilitated. There was visible peristalsis and peristaltic movements could also be palpated. A tumor in the umbilical region was recognized, spherical in shape smooth, tense, of an elastic consistence, and about the size of the head of a fœtus.

It could be moved in all directions and was independent of movements of respiration. The stomach and intestines could be recognized as independent of the tumor. Liver and spleen were in the normal position and not enlarged. The uterus was freely mobile in the normal anteflexed position and of a size corresponding to the third month of pregnancy. The right and left adnexa were palpable, not adherent, and free from contact with the tumor.

The urine contained no albumin, sugar or other pathological elements. Fæces were negative.

The probable diagnosis, considering the mobility of the tumor and its negative relations with the genital organs, spleen and intestines, was that of a cyst of the mesentery.

Under ether anæsthesia and with the assistance of Dr. Davanzo the abdomen was opened with a longitudinal median incision. As soon as the wound margins were separated a retroperitoneal tumor. presented to view. It was spherical, fluctuating, very mobile, but attached by a short pedicle. The stomach and transverse colon were displaced upward. The omentum was lifted and with it the transverse colon, the mesentery was incised and with it the posterior parietal peritoneum, when we came in direct contact with the tumor. The blood vessels which presented were ligated, the tumor was disengaged gently and cautiously from its abundant adhesions. The short pedicle was thus reached which united the tumor directly to the head of the pancreas. Owing to the risks presented in working in a field presenting so many difficulties, it was decided to resect the tumor with its pedicle and ligate the stump. After the tumor was removed some white round vesicles full of clear liquid remained and were identified as echinococcus cysts. These were carefully excised. The pedicle was fixed to the peritoneum and with it to the abdominal wall. A drainage tube was inserted as suppuration was present in the abdomen. The extirpated tumor was as large as the head of a fœtus: the longitudinal diameter was 18 centimeters, the transverse diameter 12 centimeters, and the circumference 30 centimeters. The tumor was perfectly smooth

with a wall 1 centimeter thick. It contained numerous cysts of various sizes, white in color, and full of a transparent fluid. These were daughter and granddaughter cysts of a unilocular echinococcus cyst. The fibrous wall was thick and resistant. The postoperative course was of the best, the patient had no fever. Drainage decreased daily. The drainage tube was withdrawn leaving a 5-centimeter fistula. On the eighteenth day the patient suffered with severe metrorrhagia and with colic-like pains in the abdomen, similar to labor pains. The pain was due to an incipient abortion. Hæmorrhage as a result of the abortion was profuse and as it was only after 6 hours after the commencement of the hæmorrhage that proper treatment could be instituted, it was too late even to inject stimulants, and the patient died within 2 hours, from exsanguination.

At necropsy on the following day, Dr. Giachini found acute exsanguination of all the organs which were healthy. A stylet introduced in the fistula in the abdominal wall could be passed through for 5 centimeters or to the lower part of the head of the pancreas which was also enlarged, and here the fistula terminated. The other organs were free from parasites and the necropsy confirmed the diagnosis of unilocular echinococcus cyst of the head of the pancreas.

Cappelli. Policlinico, 1919, sect. chir.

G. H., age 72, native of Romagna, had a hydatid cyst which was not diagnosed before operation, or, rather, a diagnosis was made of echinococcus cyst developed in the inferior posterior aspect of the liver. The cyst was suppurating. The patient had complained of digestive disturbances, gastralgia and had been fed almost exclusively on fluid substances. Examination showed in the highest part of the epigastric region immediately beneath the ensiform apophysis a slightly bulging area. Eliminating other possible diagnoses, a diagnosis was made of echinococcus cyst developed in the posterior part of the liver and extending between the liver and the stomach and pushing in front of the gastrohepatic omentum.

At operation (the cyst was opened through the gastrohepatic omentum), we found that we were mistaken in our diagnosis as to the site of the tumor. The cyst had developed from the pancreas without producing any symptoms whatever due to the location. No examinations for the presence of possible pancreatic ferments were made after operation because the liquid was lost.

Recovery was more rapid than usually follows the treatment of cysts by the method of marsupialization. The rapidity of recovery was due in part to the easy enucleation of the cyst, except for the resistant adhesions. The cyst was almost spherical in shape, with its neck implanted upon the pancreas. The cystic infundibulum which remained easily developed adhesions on the internal surfaces eliminating the cavity. If the special characteristics of the cyst and its anatomic relations with surrounding organs and tissues had not permitted a free enucleation and direct observation, the cyst even at operation would certainly have passed for one of the liver.

Cases taken from the records of Hauser:

Pean. Patient, age 27, had been given up as incurable and had been in a condition of great nervousness and extreme debility for the past 2 months. He presented upon admission a cystic tumor situated in the upper part of the mesentery. Operation was performed on April 23 by Dr. Barrault. It was necessary first of all to separate the extensive adhesions. After having liberated the inferior part of the duodenum and the jejunum, it was found that these had been fused with the external lamino of a cystic tumor which covered the pancreas. Exploratory puncture resulted in obtaining two liters of clear liquid which contained scolices of echinococcus. After the incision and extraction of the hydatid, it could be seen that the cyst belonged to the pancreas. Recovery retarded by fæcal fistula.

Bobrow. N. E., age 27, a retired official, was operated upon in 1897. Symptoms before operation were nausea and oppression in the region of the epigastrium, dyspepsia, and icterus. The liver was rather hard and enlarged and its surfaces smooth and shining. The gall bladder was larger than a hen's egg, tensely distended by a liquid content, and could not be reduced in size by pressure. The common bile duct was also distended and about the size of a finger. It was adherent to a globular fluctuating tumor located apparently in the head of the pancreas. The duodenum resembled an aplastic tube and ran underneath the tumor. Diagnostic puncture resulted in the release of a clear transparent liquid in which succinic acid was immediately found. The intervening tissues were penetrated through the entire thickness of the pancreas, and the cyst was found at a depth of about 2 centimeters. The cyst was extracted *in toto*. Patient recovered.

Vegas and Cranwell. A boy of 14 years, of French nationality, had been in Buenos Aires for 5 years. Five months ago he complained of icterus of variable intensity. The urine was darkly colored. For some time he had complained of pain on the right side of the thorax. Upon admission October, 1900, the skin presented a greenish olive color varying to yellow. The same color was present in the mucous membranes, and particularly the scleræ. Heart and lungs were negative. Upon inspection of the abdomen a moderate dilatation in the region of the liver was noted. Patient was then examined under ether. At the upper part of the gall bladder was a tumor the size of a pear and below this a second more voluminous one, which could not be exactly outlined. There were great quantities of biliary pigments in the urine, but no albumin or sugar. Exploratory laparotomy was performed, with uncertain diagnosis. Because of the probability of the presence of gall stones the greatly distended gall bladder was opened up. A dark liquid, thick, and viscous was obtained in which was sand and small stones. The common bile duct was not obstructed. After suturing the gall bladder the

tumor was recognized, situated in the deeper part of the head of the pancreas. Puncture of the cyst showed the content of clear, watery liquid. The chitinous membrane was incised and extracted and the wound closed. Because of the danger of infection the wound was opened up on the third day, followed by the discharge of pus. Fever gradually disappeared. Icterus faded. Patient recovered.

Martin. (Clin. Chirurgica. Greifswald. Prof. Bier.) A servant, age 71, had been ill for 7 months. He complained of severe pains in the shoulders, nausea and acid eructations, pains in the stomach and vomiting of blood ever since the illness. In April, 1902, he vomited daily after eating, showing evidences of obstruction. He was sensitive to pressure in the umbilical region and left side of the abdomen. Stomach was negative to physical examination. The tongue was coated. Below the stomach a resistant tumor was palpated which was deeply situated and yet reached to the anterior abdominal wall. The proof of dilatation of the stomach is seen in a slight displacement of the tumor. Examinations of the stomach contents were all negative.

The diagnosis lay between indurated ulcer of the stomach and pancreatic tumor. After opening the abdominal cavity it was evident that the tumor was of the pancreas. It was about the size of a fist, and upon opening it echinococcus cysts escaped. As the pyloric walls appeared thickened and indurated a gastro-enterostomy was performed. Recovery was uneventful. About 6 months later the abdominal pains and bad general condition returned. No resistance could be palpated in the depths, however.

Villar. Villar operated upon a patient for hepatic echinococcus in May, 1900. In July, 1902, he operated again finding twelve cysts in the greater omentum and mesentery. Two were found in the spleen, one of which was extirpated with a portion of splenic tissue and the other sutured to the abdominal wall. A cyst, about the size of a mandarin orange, was found in the pancreas. As this cyst could not be extirpated the method of "capitonnage of Delbet" was tried. The patient was discharged on August 5, completely recovered.

Yonnescu. Patient, age 44, was admitted October 17, 1904. He had an abdominal tumor almost the size of an orange between the epigastrium and right hypochondrium. Lateral mobility of the tumor was quite marked. The tumor also moved vertically with the liver following respiratory movements. The general condition of the patient was bad. He was cachectic, icteric, and fats were eliminated in the fæces without digestive change. At operation on October 26, 1904, a hydatid cyst of the head of the pancreas was found which had ruptured during manipulation. The germinative membrane was extracted, the content of the cavity mopped out with sterilized compresses and the entire cyst sutured, thus eliminating the cavity. After the operation icterus disappeared, the general condition improved and digestion of fats was better. Patient was discharged recovered on November 23, 1904.

Mokrowsky. P. E., age 25, employed as a clerk. Patient was admitted September 17, 1902. Complained of a tumor in the region of the stomach which had been present for about 2 years. In the beginning it was about the size of a walnut, painless and disappearing with pressure. It was more easily palpated 2 hours after a meal. A year later the patient could distinguish another tumor behind the original one. This was also painless. In the last 4½ months he has had attacks of pain and evidences of obstruction. There has been no vomiting nor icterus at any time. The upper abdomen is distended. On the left side below the costal margin a prominence is seen. A tumor is seen extending both to the right and left of the median line in the upper abdomen. It is spherical but contains accessory bulgings. It follows the movements of the diaphragm in respiration. Palpation of the tumor is painless. There is a prominent bulging on the right which shows fluctuation. A similar prominence on the left side is dense and non-fluctuating. Both prominences are of almost the same size, about 6 to 7 centimeters in diameter. They are not situated similarly with relation to the linea alba, the left bordering the linea alba, and the right being 4 centimeters outside. The percussion of the tumor gives a dull sound which merges with liver dullness. The area of splenic dullness is separated, however, by a tympanitic zone next to the tumor dullness. Diagnosis: echinococcus cyst of liver.

Operation. September 26, 1902, by Professor Bobroff. The tumor appeared below the liver after incision of the overlying lesser omentum. Thus was exposed the duodenum which had been displaced to the right more toward the inferior border of the tumor. It could be seen at this point that the tumor belonged to the head of the pancreas. The tumor was a little larger than the head of an infant, of firm consistency and somewhat fluctuating.

Upon opening the tumor a small amount of green, purulent material was first obtained, soon followed by the discharge of a clear, watery liquid in which were daughter cysts.

Ribera y Sans. A. P., a woman, age 21. A diagnosis was first made of echinococcus cyst of the liver. Later it was thought the tumor was of the epigastric region and united with the liver and spleen. It was smooth, spherical, and tensely distended. Two years ago she was first troubled with pains in the right shoulder and compression of the tumor was painful. It later disappeared as symptoms of advanced cardiac disease progressed and finally terminated fatally. Laparotomy, January 23, 1893, proved the tumor to be a cyst of the pancreas. The patient left the clinic on February 18, 1893, completely recovered.

Lejars. Patient was a woman, age 55, who for the past 12 years had observed a tumor in the left upper quadrant of the abdomen. There had been a gradual increase in size, especially during the past 12 days, during which there had been fever and pain. Infection was greatly accentuated. At opera-

tion an adherent sac was found, which, upon incising, discharged numerous echinococcus cysts, some of which were quite large. The wall of the cyst was partly incised and resected, the deeper margins being clearly identified as belonging to the pancreas. The margins of the cavity were sutured to the abdominal wall. Patient died a few days later.

Briggs. Patient was a woman, age 45. She had taken sick about a year ago of stomach disturbances, often vomiting a bloody material. Emaciation was marked. Seven or 8 months later the abdomen began to enlarge. Briggs found a tumor at operation which was identified as certainly growing from the pancreas. Upon puncturing the cyst he obtained a dark colored liquid which contained remnants of hydatids. The tumor was resistant, smooth, and of the shape of a ball. It was located in the epigastrium and left hypochondrium, was mobile, and followed even slight respiratory movements.

The abdominal wall was incised from the xyphoid process to the umbilicus. A tumor was found adhering to the greater omentum, transverse colon, and stomach. By means of these adhesions a median fibrous union of several inches in length was formed. The adhesions were separated and the tumor extracted, together with the tail of the pancreas. Recovery was rapid and uneventful. Patient returned to work and gained rapidly in weight.

Microscopic examination showed the presence of a spindle celled sarcoma, which had arisen from the hydatid sac, as shown by the scolices in the neoplastic area. This case has also been reported by Mayo-Robson.

It seems that Hauser's cases are not all genuine cysts of the pancreas, also that some are only incidental to hydatid cysts of other organs. Capelli reduces the statistics to 16 cases, 6 of which were verified at autopsy, and he has added 1 case of his own. Since his article other cases have appeared in the literature: those of Verdelet, Phillips, Muller, Parlavecchino, Threudart, Graglietto, and that reported by Cardarelli and operated upon by d'Antoni. (Carozzi. La Cirugia del Pancreas, Bologna, 1919.)

THE ICTERUS INDEX OF THE BLOOD SERUM

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THE laboratory tests reported in this paper were undertaken with the object of ascertaining whether the determination of the icterus index of the blood serum gives a definite idea of the degree of jaundice, and whether it can serve as a guide to the increase and decrease of jaundice, during the progress of a disease.

The color of the skin and scleræ, and tests for bile pigments in the urine, are the means generally relied upon by clinicians to indicate the presence or absence of jaundice. Inasmuch as these methods are, at best, rather crude, a more delicate and accurate form of determining the presence and degree of so important a symptom appears most desirable. Since the bile is carried through the blood stream before its elimination in the urine, the estimation of the bile pigments in the blood serum should give definite information regarding the presence and intensity of icterus.

Muehlingradt[1] has recently described a method for determining bile pigments in the blood. Briefly, it consists of comparing blood plasma with a standard solution of bichromate of potash and diluting the plasma with physiological salt solution, until its color approaches that of the standard. The potassium bichromate solution (1:10,000) is approximately equivalent to the color of a non-icteric plasma.

I have modified this method, using serum instead of plasma. The technique is as follows:

A solution of potassium bichromate 1:10,000 is used as a standard. Five to 10 cubic centimeters of blood are obtained, and the serum allowed to separate. The serum is compared in a colorimeter (Duboscq) with the standard bichromate solution. The standard may be set at 10, 15 or 20 millimeters. The icterus index is obtained by

[1] Muehlingradt. Deutsch. Arch. f. klin. Med., 1921, cxxxvii, 1-2.

dividing the reading of the standard by the reading of the unknown. When the color of the serum is too dark and cannot be compared with the standard solution, the serum is diluted with physiological salt solution, until its color approaches that of the standard. The calculation is as follows:

$$\frac{R_x}{R_s} D = \text{Icterus index}$$

R_x = Reading of unknown

R_s = Reading of standard

D = Dilution.

Normal icterus index. In the 156 cases giving no clinical evidence of jaundice, the lowest value obtained was 1.6 (No. 4183, fracture of skull), while the highest was 12 (No. 3757, pernicious anæmia), the average being 3.6. Eleven cases showed a higher figure than 5, but less than 11; these were classified as follows: carbuncle of neck, 4 cases of post-operative hernia, cardionephritis, hæmorrhoids, pernicious anæmia, and a subacute appendicitis. One hundred and forty-four cases varied between 2.5 and 5. An icterus index varying between 2.5 and 6 may be considered as normal.

It is of interest to note that the cases of pernicious anæmia, with one exception, were within normal limits, notwithstanding the fact that all these patients had an icteric hue.

Icterus index in jaundice. The table shows the icterus index in 15 cases with jaundice. The values vary from 15 to 210. While the initial icterus index only is given in the table, many subsequent determinations showed that the gradual disappearance of the jaundice was accompanied by a decrease in the icterus index. The following cases illustrate the delicacy of the reaction.

Case No. 6138, toxæmia of pregnancy with acute yellow atrophy. The patient was admitted on October 12, 1921, intensely jaundiced. The icterus index was determined on the 13th, and was found to be 187. The urine showed a marked bile reaction and also leucin and tyrosin crystals. On October 21, the icterus index had decreased to 62, the patient still being considerably jaundiced. On October 25,

ICTERUS INDEX IN FIFTEEN CASES

Case No.	History	Icterus Index	Diagnosis	Remarks
1		128.2	Acute catarrhal jaundice	6 weeks' duration. Recovered.
5		15.2	Chronic catarrhal jaundice	At times skin slightly colored. Recovered.
3[illegible]	[illegible]28	112	Acute hepatitis	Intense jaundice. Not improved.
5[illegible]	4[illegible]9	58	Cholecystitis	Jaundiced.
5		43.6	Catarrhal jaundice	Recovered.
1[illegible]	[illegible]78	7[illegible]	Gall stones	[illegible] Bile in urine. Died after operation.
18[illegible]	1[illegible]43	15[illegible]	Obstruction of common duct	Intense jaundice with bile in urine. Died
17[illegible]	[illegible]88[illegible]	2[illegible]0	Acute yellow atrophy following salvarsan	Jaundiced. Bile, leucin, and tyrosin in urine. Died.
17[illegible]	[illegible]2	5[illegible]	Carcinoma of colon	Faint icteric hue. Died.
175	6[illegible]75	6[illegible]	Catarrhal jaundice	Skin slightly colored.
17[illegible]	[illegible]2[illegible]	39	Catarrhal jaundice	Patient jaundiced.
177	D[illegible]13	70	Hypertrophic cirrhosis	Skin slightly colored.
178	6[illegible]38	187	Acute yellow atrophy [illegible] æmia of pregnancy	Bile, leucin and tyrosin in urine. Skin jaundiced. Recovered.
179	78[illegible]8	210	Cholecystitis	Deeply jaundiced. Bile in urine.
18[illegible]	6771	92	Gall stones	Skin deeply jaundiced. Died.

the icterus index was further reduced to 31, the color of the skin was somewhat lighter than before, and the urine still showed the presence of bile. On October 31, the icterus index was 23, and on November 11, it was 14. Between October 13, when the index was 187, and October 21, when it had decreased to 62, no appreciable change in skin coloration could be detected, while the icterus index indicated a definite decrease in the amount of jaundice.

Case No. 3205, acute hepatitis in a male. The icterus index was 112 on admission, the patient showed marked jaundice, and bile was present in the urine. The subsequent determinations of the icterus index, one week apart, were, 111, 108, 103, and 105. During this time the variation of the icterus index was very slight, indicating no change in the amount of jaundice. The skin coloration remained the same.

Case No. 6409, male, carcinoma of colon, admitted October 25, 1921. The scleræ and skin of this patient were normal in appearance, and the icterus index was 12. No bile was demonstrable in the urine. At operation metastases to the liver were found, thus explaining the pathological index of 12. After operation, a jaundice developed and the icterus index rose to 56, bile being present in the

urine. Death of the patient prevented further observation.

Case No. 5883, female, acute yellow atrophy of liver, following salvarsan injection. One day before death the icterus index was 210, and bile was present in the urine.

Case No. 6771, female, cholecystitis, with common duct obstruction. The patient was admitted to the hospital on November 9, 1921, with considerable jaundice. On November 10, the icterus index was 92 and bile was present in the urine. On November 17, the icterus index rose to 120. The patient was operated upon November 19, and died on the following day.

CONCLUSIONS

The icterus index is of value in determining the presence of jaundice, and offers a more delicate and accurate means of ascertaining the increase or decrease of jaundice than does any clinical or laboratory test now generally in use.

I wish to thank Dr. De Witt Stettin, attending surgeon, for suggestions which led to the consideration and development of this problem and Adolf Bernhard, who is in charge of the chemical laboratory, for having given me valuable assistance in working it out.

A PATHOGNOMONIC SIGN OF INTRA-UTERINE DEATH[1]

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DEATH of the fœtus *in utero* is a sufficiently common occurrence to justify the presentation of any additional diagnostic aids that may be discovered. Heretofore the history, together with the subjective symptoms and the physical signs, have been the factors utilized to arrive at a diagnosis of intra-uterine death. Laboratory tests have been unsatisfactory.

In regard to the past history, syphilis, either in the father or mother, chronic nephritis in the mother, or habitual death of the fœtus from unknown causes, are the suggestive points. The patient may or may not complain of malaise with bad taste in her mouth, feeling of weight in the abdomen, nausea and vomiting, breast changes, failure to feel life, or discharge of blood or clear fluid from the vagina. The attendant may or may not note changes in the blood pressure, a slight rise in the body temperature, or a subnormal cervical temperature, stationary weight and stationary or diminished height of the fundus of the uterus, or possibly may elicit crepitation in the fœtal head bones by vaginal or abdominal palpation.

The last sign is practically the only positive diagnostic sign existing at present. In the Women's Clinic of Stanford University we have, during the past few months, made positive diagnoses of intra-uterine death by the aid of X-ray pictures of the fœtal skull, and from a review of the literature this seems to be an original observation.

It seems that very shortly after intra-uterine death, the brain tissue shrinks, which produces a typical overlapping of the fœtal skull bones. This overlapping of the fœtal skull bones seems to be pathognomonic of the condition of the intra-uterine death and gives a picture quite different from the overlapping produced by molding.

With the X-ray, the decreased size of the fœtal head from post-mortem shrinking can be determined because the cranial bones remain nearly the same size and shape. As the head shrinks, the bones overlap at times to an astonishing distance. The radius of curvature of the shrunken head becomes obviously smaller than that of the unchanged cranial bones. When both the above changes are noted in the X-ray picture it seems justifiable to conclude that the child is dead and such has been our experience in the X-ray study of 21 babies *in utero*. In this series, 3 babies were dead and presented the typical findings; 18 were alive, of which 17 showed no changes in the X-ray picture of the fœtal head and the suture lines. One baby showed marked overlapping of the skull bones due to molding caused by a long first stage of labor, but in spite of this overlapping, the skull

[1] Read before Society of the Alumni of the Sloane Hospital for Women, April 28, 1922.

Fig. 1. Shows fœtal skull of dead baby. There is extreme overlapping of the fœtal skull bones (see arrow) and the skull surface is seen to be much larger than the bulk of the skull contents.

Fig. 2. Shows overlapping of skull bones with marked shrinking of skull contents (see arrows). The skull bones show no evidence of pressure.

bones showed no disproportion in relation to the bulk of the contents of the skull.

The following are the histories of the three patients with intra-uterine death:

Case 1. Mrs. B., Clinic No. 97829, age, 42, gravida 1, para-0, registered in the Women's Clinic, Stanford University School of Medicine, August 22, 1921. She complained of amenorrhœa since May 13, 1921; no nausea; occasional headaches; pains in lower abdomen.

September 16, the fundus measured 14 centimeters above symphysis. The pelvis was normal. Labor was due, by Naegle's rule, February 20, 1922. Patient felt life on October 12. Blood pressure: 130–80.

December 13, she complained of pains low down in pelvis. She had not felt life since December 2 and thought her abdomen was getting smaller. She had a constant salty taste in her mouth. Blood pressure: 138–94. Fundus 18 centimeters above symphysis.

December 19, fundus 21 centimeters. No fœtal life. Head could be felt by bimanual examination and thought to feel soft. Patient vomited every morning. She entered hospital. Hospital history states that patient has had measles, scarlet fever, and diphtheria. Appendectomy had been done three years ago. Blood pressure: 125–85. No fœtal heart heard. Braxton Hicks contractions were present, but no fœtal movements were noted. Fœtal head could be felt above cervix, but did not give the characteristic hard feel.

Fundus measurements were as follows:

	Centimeters
September 16, 1921	14
November 30, 1921	18
December 13, 1921	18
December 20, 1921	18

December 20, 1921, X-ray picture of uterine contents showed overlapping of the fœtal skull bones with apparent shrinkage of the skull contents (Fig. 1). A diagnosis of intra-uterine death was made and labor was induced December 22 with Voorhees bags. She was delivered of a dead baby December 23. The liquor amnii was dark and dirty looking. The head was soft, showing beginning maceration. The legs and feet and parts of body were macerated. The fœtus had apparently been dead for some time.

Examination of the placenta showed many white infarcts; otherwise normal. The Wassermann was negative. Blood count: 4,024,000 red cells; hæmoglobin, 85 per cent; leucocytes, 7,000; polymorphonuclears, 69 per cent; lymphocytes, 25 per cent.

Fig. 3. Shows fœtal skull of dead baby. There is marked overlapping of the fœtal skull bones (see arrow) with some disproportion between surface of skull bones and skull contents.

Fig. 4. Shows the fœtal skull of normal pregnancy.

The urine was normal except that specific gravity varied from 1026 to 1008.

Autopsy on the baby showed definite widening and irregularity of the epiphyseal line of the rib and femur. The lungs showed definite fibrous thickening of the septa of the alveoli, otherwise negative. Diagnosis: congenital syphilis.

Case 2. Mrs. T., Clinic No. 74294, age 29, gravida 2, para-1, registered in Clinic September 21, 1921. December 30 her blood pressure was 144–90. She had been delivered by Cæsarean section on May 10, 1919, of a live baby because of eclampsia with marked œdema, granular casts, and blood pressure of 210–140.

January 13, 1922, her blood pressure rose to 160–100. Headache and œdema of legs. She entered hospital. Labor was due March 22. Fundus measured 22 centimeters above symphysis. Fœtal heart was heard in right lower quadrant. Patient left hospital February 3 with a blood pressure of 145–100, to be observed by the Social Service Department.

February 23 re-entered hospital with blood pressure of 140–85, no toxic symptoms, fundus measuring 21 centimeters. Fœtal heart could not be heard, and an X-ray picture of the abdomen was taken. This picture showed the typical findings of intra-uterine death (Fig. 2).

Shortly after returning from the X-ray Department, the membranes ruptured with a discharge of a quantity of dark coffee-colored, amniotic fluid. A dead baby was delivered with easy low forceps, and immediately after labor patient's blood pressure was 130–82.

Examination of placenta showed white infarcts with signs of infection in the placenta; otherwise normal. Wassermann was negative. Blood examination showed 4,120,000 red cells, hæmoglobin 90 per cent, 10,400 white cells, 76 per cent polymorphonuclears, 20 per cent lymphocytes. Urine examination showed a low specific gravity with light cloud of albumin but no casts.

Autopsy on the baby showed definite widening and irregularity of the epiphyseal line of the rib and femur. Diagnosis: congenital syphilis.

Case 3. Mrs. A., Clinical No. 100933, age 38, gravida 2, para-0, registered in Clinic December 9, 1921. Last menstruation was April 1. She gave no history of infections. She has had some swelling of feet and hands during present pregnancy. Married 20 years; spontaneous abortion at 4 months 10 years ago. Heart and lungs negative. Breasts large. Fœtal heart faintly heard in left upper quadrant. Child lying in occipitolaevo-anterior position. No engagement of presenting part. Fundus was 33 centimeters above symphysis. Pelvic measurements were normal. Labor was due January 8, 1922.

December 20, fœtal movements were very active. Blood pressure, 174–88.

January 4, 1922, because of hypertension, patient was given castor oil and quinine, but no labor pains resulted. Blood pressure, 146–89. Fundus was 33½ centimeters above symphysis. Fœtal heart sound in right lower quadrant, strong, regular, rate 140.

January 27, patient entered hospital with blood pressure of 150–90. Fundus 29½ centimeters above symphysis. Fœtal heart could not be heard. January 28, fœtal heart could not be heard; no fœtal movements. Braxton Hicks contractions present. Blood pressure 140–85. Bimanual examination of fœtal head gives an impression of crepitation in the skull bone, but this is not distinct.

Fundus measurements have been as follows:

December 9, 1921	33
December 20, 1921	33½
January 26, 1922	29½
January 29, 1922	29

X-ray picture of contents of uterus shows a well-grown fœtus with head floating. There is a little shrinkage of the head as evidence of overlapping of the sagittal suture (Fig. 3). Diagnosis: intra-uterine death of fœtus.

January 30, spontaneous labor began and patient was delivered of a dead baby.

Examination of placenta was normal. Wassermann negative for both husband and wife. Examination of blood shows hæmoglobin 75 per cent, 9,250 white cells, polymorphonuclear 66 per cent, lymphocytes 24 per cent. Urine examination normal, except for a slight trace of albumin.

Autopsy on the baby showed very marked widening and degeneration of the epiphyseal line of the rib and femur. Diagnosis: congenital syphilis.

CONTROLS

The fœtal skull *in utero* has been studied by means of X-ray pictures in 27 patients with normal pregnancy. In no instance can there be seen any overlapping of the fœtal skull bones or any diminution in the size of the skull contents (Fig. 4).

One patient with normal pregnancy had rupture of the membranes with beginning labor. She had a long first stage of labor lasting 43 hours, due to rigidity of the cervix, but was eventually delivered of a live baby. An X-ray picture taken late in the first stage of labor shows marked overlapping of the fœtal bones, but there is no sign of diminution of the skull contents. This overlapping can be easily differentiated from that produced by intra-uterine death (Fig. 5).

Fig. 5. Shows the fœtal skull of live baby with overlapping of skull bones (see arrows) due to long first stage of labor. There is no diminution of the skull contents as shown by the bulging of the skull bones between the lines of suture. The right pubis indents the coronal suture.

CONCLUSIONS

From a study of fœtal skulls with the X-ray in 31 cases of pregnancy, it has been found that with live babies the fœtal skulls appear normal except for the effect of labor which produces an overlapping of the skull bones. In three cases of intra-uterine death, the X-ray picture showed the marked overlapping of the skull bones with distinct signs of shrinkage of the skull contents.

From these facts we believe it is justifiable to state that shrinkage of the skull contents with overlapping of the skull bones can be demonstrated with the X-ray, which gives a pathognomonic sign of intra-uterine death.

Thanks are due to Dr. Hans von Geldern, resident in obstetrics and gynecology, for assisting in the study of these cases, and to Dr. R. R. Newell, assistant roentgenologist in the Stanford School of Medicine, who made the photographs and interpreted the X-ray findings.

ELEPHANTIASIS TREATED BY THE KONDOLEON OPERATION

By FERDINAND P. HERFF, M.D., F.A.C.S., San Antonio, Texas

A NUMBER of articles have appeared in medical literature, discussing the Kondoleon operation for the relief of elephantiasis of the extremities. As this condition is rare in the United States, we have but a limited number of cases upon which to base statistics of end-results. Since the degree of value of the operation is still debatable, all cases of this kind should be duly reported. Devised by Kondoleon, of Greece, it has been employed by Matas, Royster, Hill, Sistrunk, and others in this country. It cannot be considered a cure for elephantiasis, but is assuredly the best step so far introduced, tending to make lymphatic obstruction of limbs bearable and controllable

Elephantiasis, we will remember, is pathologically due to an obstruction of the lymphatic vessels of the part, resulting in hyperplasia of the skin and tissues, which macroscopically are thickened, waxy, and indurated.

In selecting a case for operation the following should be observed: (a) Blood Wassermann must be negative, hæmoglobin, at least 70 per cent. (b) Patient's general health must be carefully considered. Operation should not be undertaken in the presence of an active dyscrasia. Existence of a curable chronic trouble need not stand in the way of hope for a future operation. For example, one of my cases suffered from an acute empyema and fibroid tuberculosis 2 years before one leg was surgically treated. (c) Every means of reducing the size of the limb must be thoroughly tried previous to surgical interference, such as rest in bed and elevation of the member; care of the skin, particularly if ichthyosis and local patches of infection exist; massage; employment of elastic bandage or stockinet.

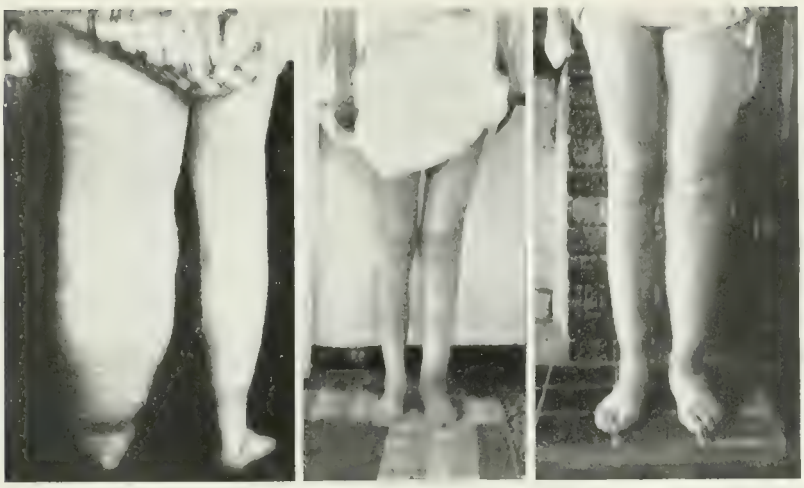
My practice has been to prepare cases in this manner, beginning 2 to 4 weeks prior to operation. These precautionary measures reduce the chance of infection and put the affected area into a more pliant state.

The principle of the operation is the establishment of a connection between the superficial and deep lymphatics — the latter generally being uninvolved. This is done by permanently breaking the fascial wall lying between the muscles and subcutaneous tissues, boldly removing wide wedges of tissue from the inner and outer aspect of the entire length of the affected limb, each wedge comprising skin, fat, and deep fascia (9).

If the enlargement is not extreme at the joints, it is an advantage to break the incision opposite them, thus avoiding a skin scar at these points. These cutaneous bridges are readily undermined, allowing an easy removal of the required amount of fascia and infiltrated fat. I do not stitch the fascia, for this tissue is usually so thick and waxy that it seems unnecessary to tack it in place. The muscle substance is not to be broken into. This point is important, for it eliminates the chance of painful adhesions. An assistant inserts dry gauze packs as fast as the sluices are cut, over which the flaps are firmly compressed, following the operator as he proceeds. After the entire sulcus has been fashioned, the larger bleeding points are caught but not ligated until all secondary trimming has been completed, thus avoiding re-tying.

I employ drainage, because this is an aid to the general reduction of the limb, allowing lymphatic material to escape; besides, it is the logical thing with so much raw surface.

It is inadvisable to operate upon both sides of the limb at one time, the better plan being to attend to corresponding sides of the extremities at the same sitting. In the leg the outer surface should be attended to first, because, when operating upon the inner aspect the long saphenous system is necessarily interfered with, which tends to throw an added strain upon the drainage of the leg. At the second sitting there is already established a communication between the deep and superficial lymphatics of one side of the leg and a general reduction of the limb having taken place, the saphenous vein and its tributaries can be better spared. The one



a *b* *c*

Fig. 1. Case 1. *a*, 6 months before operation, calf 26 inches, thigh 27 inches. *b*, 2 months after final operation, normal leg, calf 12½ inches, thigh 13½ inches, affected leg, calf 13 inches, thigh 14 inches. *c*, One year after operation, calf, 14½ inches, thigh 15 inches. Note slight tendency to enlargement. Tissues, however, soft and pliant.

advantage of the asymmetric plan of attack is that it allows the patient the comfort of lying upon one side.

The second operation should not be undertaken until at least 6 weeks after the primary and not then if there is a discharging sinus along the track of the former incision. After operation, the limb should be firmly bandaged and elevated and if drained, dressed daily. Patient should not be allowed to hang member down, or step upon it for at least a month after operation and then should not do so without the employment of a pressure bandage or elastic stocking.

The patient must not be led to believe that a complete cure requiring no further attention can be attained. It must be made clear that some sort of support, preferably in my opinion an elastic stockinet, must be worn for the balance of life. Also, light massage must be employed from time to time.

In summarizing my experience with the operation, I glean the following facts:

1. The Kondoleon operation is a commendable surgical procedure and the only one that gives any real relief.

2. It is not a curative operation, for there is a tendency toward return of the enlargement of the involved extremity, especially if unsupported.

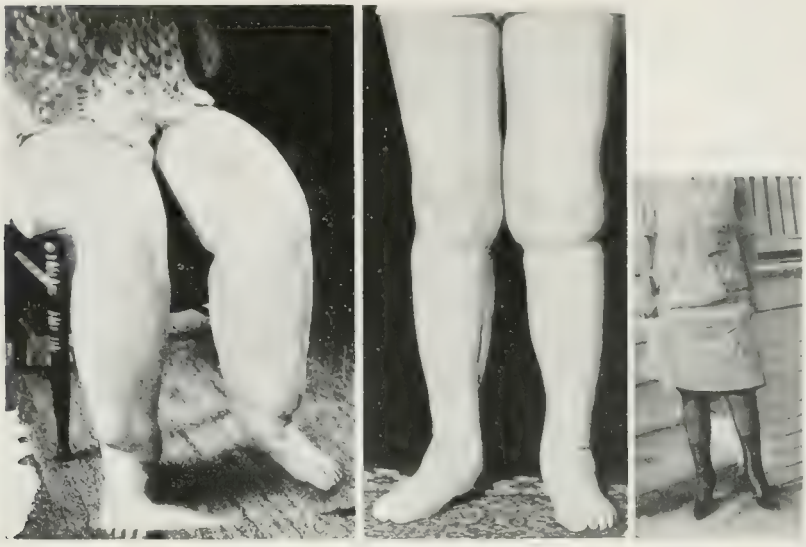
3. Its recurrence in most cases can be held in check much more readily than the original enlargement could be controlled.

4. Patient is rendered decidedly more comfortable and does not suffer from pain or ill effects following the operation.

I submit three case reports as follows:

Case 1. H. W., female, white, age 23. Twelve years ago patient noticed slight swelling in left ankle every evening. It was painless at first, but after 4 months was painful. Swelling gradually spread over entire leg and became permanent. Eight years ago leg attained its maximum size, and the tissues became more brawny. Two years ago patient's general health declined and a diagnosis of fibroid phthisis was made; shortly after, patient underwent empyema operation. Following this, she came under my care suffering with marked secondary anæmia and fibroid pleurisy. One and one-half years ago she had sufficiently improved to warrant Kondoleon operation. The outer surface of leg was attended to, and in 6 weeks the inner side. Though there has been some recurrence, she is highly satisfied with result and is ready again to undergo operation, if necessary.

Case 2. Mrs. H. B. M., female, white, age 40. Twenty-one years ago patient noticed swelling of the ankle of left leg. This gradually grew more marked and became permanent. Four months after, swelling developed in right leg. Both limbs increased in



a *b* *c*

Fig. 2. Case 2. *a*, 2 years before operation. *b*, 4½ months after final operation. *c*, 4½ months after final operation. (Notice how comfortably she wears shoes and stockings.)

size and induration until 8 years ago, when maximum size was attained. This maximum size continued until the operation, except in the right thigh, which, a few months before the Kondoleon, diminished slightly in circumference, and was painful. Patient had all palliative forms of treatment before June 30, 1921 (date of operation). The outer sides of both limbs were operated upon, and 6 weeks later the inner surfaces. So far she is well satisfied with result.

Case 3. Mrs. S., female, white, age 42. Following childbirth she noticed swelling in right calf, attended by slight soreness. For 3 years, this swelling gradually increased and the leg became brawny and indurated, and unwieldy to move. There was no swelling above the knee. Circumference was 7.5 inches larger than the normal leg. Re-examination 18 months after operation, discloses slight tendency to enlargement. Possibility of recurrence had not been explained to patient and she is not well satisfied with result.

Fig. 3. Case 3. 1½ years after operation,—slight tendency to return though tissues are soft. There is still a reduction of 6 inches from the original enlargement.

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TRAUMATIC ORBITOFACIAL EMPHYSEMA

By GEORGE G. DAVIS, M.D., F.A.C.S., Chicago

TRAUMATIC facial emphysema is not a common complication of face injuries, but when it occurs it is usually secondary to fractures of the nasal bones. More rarely it occurs from fracture of the lacrimal, ethmoidal, or frontal bones. Brav (1) reported a case of orbitopalpebral emphysema caused by perforation of a dental canal.

In Brav's case, a dentist, while drilling on the mesial root of the right upper first bicuspid accidentally perforated, by way of the dental canals, into the antrum of Highmore and farther through the bony roof of the antrum, making an opening through which air escaped into the subcutaneous tissue. Immediately following the accident, the lids of the right eye began to swell until the eye was entirely closed and this emphysematous condition quickly involved the right side of the face as far down as the neck, giving an asymmetry of the face as the result of the unilateral swelling, which was rather hideous in appearance. The patient suffered no pain from the condition. A pressure bandage was applied for 2 days, and the emphysema disappeared at the end of 5 days.

Potter (2) reported a case of hydropneumo-cranium, with air in the ventricles, which was the result of a fracture of the frontal bone. The patient, a male, aged 40 years, fell from a height of 15 feet, striking mainly on his hands and face. Skull plates disclosed a frontal skull fracture, comminuted, somewhat stellate, centering about the right supra-orbital arch, and involving both the internal and external walls of the frontal sinus and the orbital plate. Inside the cranium, at the site of fracture, there was evidence of gaseous accumulation, in volume and shape comparable to a small hen's egg. This was noted 3 weeks after the injury. Two weeks later there was considerable increase in the volume of the subdural gas chamber, and the lateral ventricle was also appreciably gas-filled. The air in the cavity was displaced by fluid and gradually disappeared.

In 1905, McArthur (3) reviewed 33 cases of external pneumatoceles of which 23 were

Fig. 1. Roentgen-ray, anteroposterior view, taken December 4, 1921, one day after injury, showing semilunar shaped air spaces in the superior portion of either orbit.

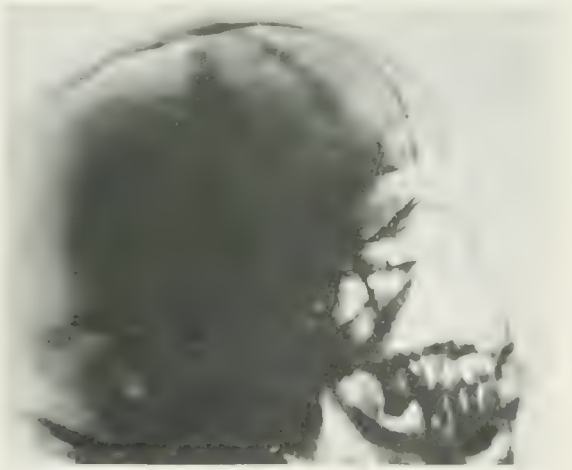

Fig. 2. Roentgen-ray, lateral view, taken December 4, 1921, one day after injury, showing air spaces in the superior portion of the orbits and also the rather spacious pneumatic areas of the frontal sinus and thin walls of same.

Fig. 3. Photograph, taken December 7, 1921, 4 days after the injury, showing discoloration about the bridge of the nose and in the infra-orbital regions.

in relation to the mastoid and 10 to the frontal sinus. Ten developed after trauma and in 10 cases also there was evidence of pre-existing bone disease which was considered a predisposing factor to the development of pneumatocele after slight trauma. Also some history of increased air pressure in the buccal and oral cavities was frequently given.

J. K., a laborer, age 45, on December 3, 1921, was struck in the sacro-iliac region by a blow of considerable force, which caused him to fall forward on the floor, striking his face. He was taken immediately to the hospital, where it was noticed that he had a hæmorrhage from the nose, blood escaping from both nares. There was a contusion of the frontal region with marked swelling and discoloration at the bridge of the nose.

Shortly after the injury he blew his nose, following which, there was considerable swelling which came on rather suddenly. This extended upward well onto the forehead and downward, involving the bone of the nose and both cheeks and eyes. Palpation of the affected area produced a typical crackling, the skin felt as if it were floated up from the underlying bone by an effervescing liquid; the air could be driven from one place to another by the fingers, and pitting on pressure was apparent.

Skull plates taken the day following the injury showed air in both orbits, but no well-defined fracture could be noted. In the anteroposterior view (Fig. 1) semilunar-shaped air spaces were noted in the superior portion of either orbit. A lateral view (Fig. 2) also revealed the air spaces in the superior portion of the orbits and also rather spacious pneumatic areas of frontal sinus and its thin wall.

From the day of the injury, the swelling (emphysema) gradually decreased. On the fourth day there remained but one small area over the bridge

Fig. 4. Roentgen-ray, anteroposterior view, 8 days after injury, showing that the semilunar-shaped air spaces in the orbital regions have disappeared.

of the nose that crackled on pressure. Discoloration (Fig. 3) of the tissues about the bridge of the nose and in the infra-orbital regions was marked at this time. Eight days after the injury another skull plate was made in an anteroposterior view (Fig. 4), and it was noted that the semilunar-shaped air spaces in the orbits had disappeared and there were no further signs of air being present in the tissues. At no time was there air within the cranial cavity, as seen in Potter's case, nor air between the cranium and periosteum as noted in cases of pneumatocele of frontal region reviewed by McArthur.

The manner in which the air entered the orbits and soft tissues about the upper half of the face in this case is not definite either from physical examination of the patient or roentgenographic examination of the skull. However, the skull plates disclose very large pneumatic spaces in the frontal sinuses, and the walls are very thin and irregular. It seems probable that a fracture of the frontal sinus entering into the orbits was present. The blowing of the nose, causing an increased air pressure in the buccal and oral cavities, was the immediate cause of the sudden emphysematous condition.

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A STUDY OF EXPERIMENTAL PYLOROPLASTY[1]

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ONE hears from various sources expressions of dissatisfaction with present methods of dealing with pyloric obstruction. On the one hand, the operation of gastro-enterostomy, while technically a highly perfected operation and one which has done great service to mankind in the relief of suffering and the saving of life, is yet an operation which does such violence to the physiological relationships in the upper digestive tract that it must always fall far short of being an ideal surgical procedure. The complications and unfortunate sequelæ, which are sometimes met with, are well known and need no discussion. These and also those more vague after-effects, which sometimes follow this operation, while not of sufficient frequency to discountenance the operation, are yet a constant stimulus in the attempt to find a more physiological method of treatment. With regard to the various pyloroplasties, on the other hand, of all which have been devised, the relative infrequency with which any is used (with the exception of the Rammstedt operation in congenital stenosis) is eloquent testimony that they are surrounded by greater doubt and difficulty than is gastro-enterostomy.

It is not the purpose to discuss here the various pathological conditions of the pylorus which result in obstruction, nor the different operative difficulties to be overcome in dealing with the different lesions. Dogs, unfortunately, do not furnish obstructions at the will of the investigator, so we were compelled to work with normal tissues and have directed our attention to the general operative possibilities of this region rather than to the treatment of any particular lesion.

Our first problem was the adaptation to the pyloric region of the principles of pedicled flap operations which have gained such wide application in plastic surgery. Some difficulty was encountered in obtaining a flap to which a free blood supply could be preserved. This was finally done in the following manner. The proximal end of the duodenum and the adjacent end of the stomach were opened up by an incision starting on the ventral aspect of the duodenum about 3 centimeters beyond the pyloric sphincter and extending back through the pyloric sphincter and the ventral wall of the stomach to a point in the stomach about 4 centimeters proximal to the pyloric ring. From this point two curved incisions were made almost to the greater curvature of the stomach and including between them a flap of the stomach wall in the shape of a half crescent. This flap could always be so chosen that it had a good blood supply at its base from one or two large branches of the right gastro-epiploic artery. This crescentic flap was then drawn into the first incision, the tip of the flap fastened at the duodenal extremity of the incision, and, after trimming away any redundant mucosa, the flap was firmly fixed in its new location by a line of continuous suture carefully placed so as to secure complete hæmostasis and edge-to-edge approximation but no inversion of the edges. The incisions made in outlining the flap were closed by lines of suture extending to either side from the base of the flap. The plan of this operation is shown in Figures 1a and 1b.

The operation described was performed on a series of eight dogs. On four of these dogs, the incisions were made through all the coats of the stomach and duodenal walls. On the other four dogs of the series, an exactly similar operation was done, except that all incisions were made only to the

[1] The work upon which this paper is based was done in 1916 and 1917, in the Department of Surgical Research of the University of Pennsylvania, and the results were presented at the tenth annual meeting of The Undergraduate Medical Association of the University, April 20, 1917. Publication at that time was prevented by the military service of the authors.

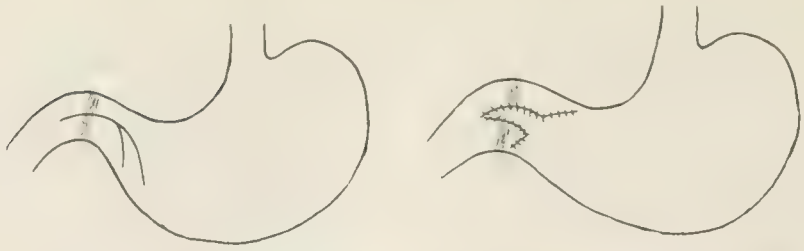

Fig. 1.—*a* (at left), Incisions for the plastic flap operation. *b*, Lines of suture used in transplanting the flap into the pylorus and in closing the stomach incisions.

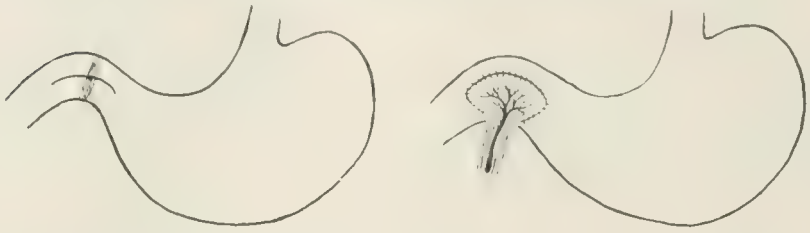

Fig. 2.—*a* (at left), Incision of stomach and duodenum to receive jejunal transplant. *b*, Jejunal transplant sutured in place.

submucosa. Thus, without having entered the lumen of the stomach or gut, a seromuscular flap was taken from the wall of the stomach and sutured into the incision which had been made through only the outer coats of the pylorus. In these operations, if a double row of sutures is used, inverting the edges as is customary in gastro-intestinal work, the inverted edges encroach to such an extent on the lumen of the canal at the pyloric ring that the net result of the operation is to decrease the lumen and not to enlarge it. To avoid this and secure a true enlargement, we made a single continuous suture to secure edge-to-edge approximation but never any inverting suture to get contact of serous surfaces. Instead, the pylorus was covered with a free edge of omentum which was held in place with two or three interrupted sutures.

The recovery of all eight dogs was uncomplicated. The dogs were autopsied at dates varying from 2 weeks to 6 months after operation. None showed any extensive peritoneal adhesions or other evidence of peritonitis. In all, the pylorus appeared to be functioning normally. The omentum, somewhat thickened, was still closely adherent where it had been attached at the time of operation. No marked enlargement had been secured in any case. The seromuscular flaps showed a marked tendency to retract to the original site, leaving little evidence of ever having been in the pylorus. The flaps which included all coats retained better their new position and could be easily recognized on the mucosal surface where the strip of gastric mucosa contrasted sharply with that of the duodenum into which the flap extended. The tissues were healthy, but the flap dimensions were decreased, and the pylorus had returned to almost its normal size. In two or three cases where the retraction of the flap was quite marked, there was evidence that the flap had exerted a definite pull, for the duodenal mucosa had been thrown into folds which converged to the point where the tip of the flap was attached. It furthermore appeared that this "pull," acting on the muscular coats, was helping to restore the pyloric ring, for the cut fibers, which the flap had separated, were being brought close together as they were pulled after the retracting flap.

To test the action of the pylorus in the presence of a really marked enlargement, we next implanted into a large incision through

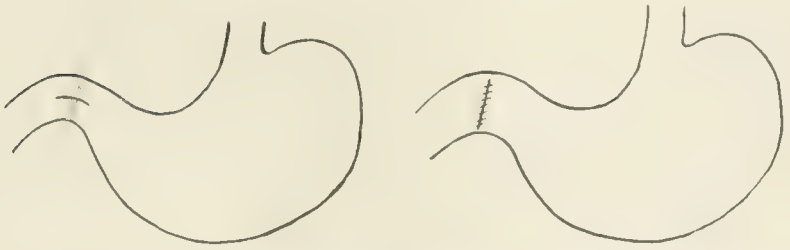

Fig. 3. *a* (at left). Incision for the Heineke-Mikulicz and Fredet operations. *b*, Transverse closure of pyloric incision in the Heineke-Mikulicz and Fredet operations.

the pylorus, a piece of jejunum which was obtained and inserted as indicated in Figures 2a and 2b. The segment of gut resected was opened along its antemesenteric line. The retangular piece of intestine, thus obtained, was trimmed to a suitable shape and sewed into the opening which had been made in the pylorus. A good blood supply was preserved for this flap by a mesenteric pedicle, containing one of the larger mesenteric branches.

The two dogs of this series made a good recovery. One, at autopsy 5 weeks after operation, showed the pylorus greatly increased in size by the large bulging flap. The flap tissue was healthy and was still getting some of its blood supply from the pedicle in which a pulsating vessel was easily seen. The other dog of this series, when killed 7 months after operation, showed a markedly enlarged pylorus with the flap tissue healthy, but there had been a slight decrease in the size of the transplanted flap and the mesenteric pedicle, with its blood vessels, was reduced to a thin fibrous band.

Next, on a series of four dogs, we performed an operation as illustrated in Figures 3a and 3b. This is the Heineke-Mikulicz operation slightly modified, in that the sutured edges were not inverted and, in two of the dogs, the incisions were made only down to the submucosa, as done by Fredet (1). These operations gave, at the time of operation, a moderate enlargement of the pylorus, but when autopsied, at periods varying from weeks to months after operation, none of these animals showed any permanent enlargement of the pylorus.

On another series of eight dogs, we performed the Rammstedt operation (2), with the exception that whereas the Rammstedt operation is merely an incision through the muscular coats of the pylorus allowing the mucosa to bulge, we, in some of the dogs, to exaggerate this and test the safety of the procedure, resected a strip of the serous and muscular coats to allow still greater prolapse of mucosa (Fig. 4). In a few cases, while resecting the seromuscular strip, the mucosa was accidentally punctured and had to be closed with a fine purse string suture. In all cases the pylorus was finally covered with an edge of the omentum.

All these dogs made good recoveries. A few were reopened, under ether anæsthesia, after varying periods of time, that we might observe, during active peristalsis, the action of the pylorus after operation. We were able to observe that when a peristaltic wave reached the region where the muscle wall had been cut, the contraction of these fibers, instead of causing a constriction in this region, caused an even wider gaping and an increased bulging of the mucosa. This intermittent pulling apart of the edges of the muscular wound by peristaltic contractions would seem to be the explanation of the fact, already clinically recognized, that after the Rammstedt operation, recurrence of stenosis is exceedingly rare (3). On autopsying these dogs, we found the cut edges of the muscular coats to be still gaping widely. In some cases the bulging mucosa was partially restrained by the overlying omental transplant, but there was no tendency toward stricture.

The objection is sometimes raised that the Rammstedt operation creates a dangerous weak spot in the gastro-intestinal wall. With this in view, we tested five of the dogs of this

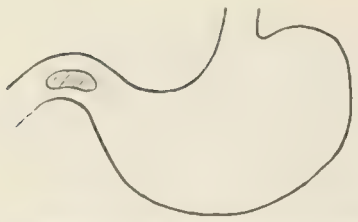

Fig. 3. Showing area of serous and muscular coats removed.

series as follows: At autopsy, the stomach and duodenum were removed in one piece. We then attached one end of the specimen to a gas tank, the other to a pressure gauge, and slowly inflated the specimen until rupture occurred. Rupture took place, in every case, not at the site of operation, but in the cardiac end of the stomach. The average pressure at rupture was 4¼ pounds per square inch. In two cases, further test was made by inflating only the pyloric end of the stomach and of the duodenum. In these cases, rupture did not occur until an average pressure of 11 pounds was reached, and still rupture did not take place at the site of operation but toward the stomach end of the specimen. Different investigators have reported intragastric pressures for the pyloric end of the stomach, varying from 25 to 162 centimeters of water (4, 5). In our tests, there was required to rupture this region of a stomach, a pressure equivalent to 748 centimeters of water. Thus it is seen that the areas subjected to the Rammstedt operation resisted successfully a pressure four and one-half times the maximum intragastric pressure reported.

To test further what factor the muscular coats constitute in the mechanical strength of the gastro-intestinal wall, we took segments of jejunum from a dog just killed and tested the degree of pressure required to rupture the segments under the following conditions: (1) with all coats intact; (2) with an incision made through the serous and muscular coats down to the submucosa; (3) with an incision made from inside the lumen through the mucosa and submucosa, leaving the muscle intact.

Each of these tests was repeated three times. We found that to rupture the intact wall of this region required an average pressure of 17 pounds. With an incision through the serous and muscular coats, it still required an average pressure of 17 pounds to cause rupture, and rupture did not always occur at the site of the incision. With the mucosa and submucosa cut, on the other hand, the average pressure at rupture was 10 pounds and rupture took place, in each case, at the site of incision.

It would thus seem that the resistance of the gastro-intestinal tract to a distending force is not appreciably decreased by cutting the muscular coats. Further, it is evident that there is a large factor of safety in the mucosa and submucosa alone for they were able to resist a pressure many times greater than the highest recorded by Cannon in his review of the literature on intragastric pressure (6).

CONCLUSIONS

1. A plastic flap operation or the Heineke-Mikulicz operation can secure, temporarily, a true enlargement of the pylorus, if the edges sutured are not turned in.

2. A normal pylorus, enlarged by any of the foregoing procedures, except the Rammstedt, tends to return toward its normal size. Whether a stenosed pylorus, thus operated upon, would return to its former stenosed condition or would retain a lumen of normal size, is still uncertain.

3. A plastic flap operation is unsatisfactory on account of requiring such extensive incisions into the lumen of the canal. It is also unsatisfactory on account of its tendency to retract and restore the divided pyloric sphincter.

4. The Rammstedt operation, or so-called "partial pyloroplasty," is, when conditions will permit, the most effective way of enlarging the pylorus. It has the advantage of being the simplest operation yet devised for this purpose and requires very little time under anæsthesia. The objections sometimes raised are:

1. Danger of hæmorrhage from the exposed submucosa;

2. Danger of peritonitis from puncture of the mucosa;

3. Recurrence of stenosis;

4. Danger of rupture at the "weak spot" created.

The first two of these dangers can be avoided if extreme care is used in performing the operation. The third has already been answered clinically (3). The fourth is shown to be unfounded on account of the large factor of strength residing in the submucosa.

We feel that the principle of the Rammstedt operation should not be confined entirely to cases of congenital stenosis but should be given more general application in the surgery of the pylorus.

NOTE.—Since the presentation of this paper there have been a number of additions to the literature on this subject. We would call attention especially to the following:

1. The report by Downes of a new and larger series of cases of use of the Rammstedt operation in congenital stenosis (7).

2. The report by Graham on the use of the Rammstedt operation in a case of pyloric stenosis in an adult (8).

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EXPERIMENTAL RECONSTRUCTION OF THE ŒSOPHAGUS BY GRANULATION TUBES

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VARIED attempts by widely different operative procedures have been made to solve the problem of reconstruction of the œsophagus after removal of segments of the organ. It has been realized for a long time that this is a basic problem in the surgery of œsophageal stenosis, for, whether the lesion is a benign or a carcinomatous stricture of the organ, the ideal would evidently be a restitution of the passage for food after operative removal or side-tracking of parts of the organ. The many experimental and occasional clinical efforts that have been made with this purpose in view have consisted either in partial or in total œsophagoplasty. It would lead too far afield to enter into the details of these methods. In brief, it may be said that the earliest plan was the formation of a skin tube fashioned from the skin of the anterior chest wall, to which the œsophagus above the stricture was attached superiorly, and the stomach below. Later developments consisted in the use of implants of loops of small or large intestine isolated in various ways, and, finally, tubes or flaps from the gastric wall were employed for this purpose.

Experimentally, these methods have been followed by occasional successes, and there are a few instances in which clinically, too, they have proved satisfactory. In the human being such procedures involve multiple operations over a period of many weeks or months, with the ever present likelihood of failure from complications, infection or gangrene of the isolated portion of the hollow viscus, etc. The technique of these œsophagoplasties is complicated, and the patient must necessarily be in good physical condition to withstand the several major operations. In fact, against the few successes that have been reported, there is the probability of a much larger proportion of unreported failures and an operative mortality that is not negligible.

If progress is to be made in this field it is essential, we believe, to separate the problem of œsophagoplasty into two distinct parts—a plan of operation adaptable for benign stenosis and one for cancer of the œsophagus. In the former, a considerable length of the

organ may be involved or the strictures may be multiple; the patient is usually young and in good physical condition, and the problem is one of sidetracking and not of removing the disease. In cancer of the œsophagus the patient is ordinarily old and debilitated by the disease; and the problem is one of replacement of relatively short segments of the organ. It is the latter problem that has engaged our attention in the experimental studies.

Before describing the experiments, brief reference should be made to the methods employed for re-establishment of the food channel in the two successful cases of its resection for cancer. In Torek's case no attempt at reconstruction was made. A rubber tube connected the stump of the œsophagus in the neck with a gastrostomy opening. Lilienthal employed a pedicled skin flap laid in place at the first operation, which consisted in the isolation of the neoplasm. After the removal of the growth, the skin flap was detached and the final result was a dermal channel to which the œsophageal ends became attached. The patient was a young individual in good physical condition; it is questionable if the procedure employed by Lilienthal will prove applicable to the cases of œsophageal cancer that are usually encountered. Indeed, it was from observations made during the time the brilliant series of operations were carried out in his case that we were led to perform our experimental work.

Repair of a wound of the œsophagus takes place by granulation tissue. Even a simple œsophagotomy with immediate suture will be followed by leakage until the incision in the organ is healed by granulation. An erroneous impression exists that anastomosis between the œsophagus and some other hollow viscus will be followed by repair as seen in the peritoneal cavity. The œsophagus has no serosal covering and the repair after operations upon the abdominal hollow organs depends primarily upon the existence of the serosal layer. Since repair of the œsophagus takes place by granulation, we determined to make use of this fact by establishing granulation tubes between the œsophagus stumps after resection of the organ. Our plan was to isolate a given section of the œsophagus and surround it by packings. At the next stage the isolated portion was to be resected and a rubber tube sutured in place. It was our impression that granulations would form about the tube and that the œsophageal epithelium would ultimately line the granulation tube.

The experiments comprise a series of operations performed on thirteen dogs, all under ether anæsthesia. The first operations were on the thoracic œsophagus. Attempts were made to approach the organ through the posterior mediastinum, but the pleura was invariably entered and death ensued from infection. The principles involved being the same and the technical difficulties fewer, operations on the cervical œsophagus were practiced in all the subsequent experiments. A striking fact was soon noted in these experiments on the cervical œsophagus: resection and rubber tube implantation in one stage was followed by death from infection. A suppurative process extended from the wound down the cellular planes of the neck into the mediastinum to involve both pleural cavities. The following experiment will illustrate this:

Experiment 1. Dog 1778. Weight, 25 pounds. *Operation, February 4, 1921.* Incision 4 inches, along anterior border of left sternomastoid muscle. Three inches of œsophagus were isolated from trachea and surrounding muscles, after retraction mesially of the great vessels and vagus nerve. One inch of œsophagus was resected, and a T-tube inserted and sutured into cut ends. The sternomastoid muscle, with a small arm of T-tube coming through it, was sutured, thus completing a muscular tunnel around the tube. The skin and fascia were closed. A typical Witzel gastrostomy was done.

February 5, 1921. Dog died. At autopsy the wound in the neck was found extensively infected, with pus bathing the muscles, trachea, and cut ends of the œsophagus; these ends, however, were held by the sutures to the tube. The infection extended down the cellular spaces of the neck into the posterior mediastinum, a purulent exudate covering the œsophagus, trachea, and prevertebral muscles. In addition there was a bilateral bronchopneumonia with a bilateral empyema, apparently a direct extension from the posterior mediastinum. Death was due to an overwhelming infection and sepsis.

On the other hand there have been no deaths from infection in the operation carried out in two stages, and we, therefore, regard this as the correct procedure. The technique

Fig. 1. End of first stage of operation. Œsophagus isolated from surrounding structures and packed off. In the actual operation, packings completely separate the organ from the trachea, great vessels, and muscles.

Fig. 2. End of second stage of operation. A portion of the œsophagus has been resected and replaced by a rubber tube, sewed into place above and below. The tube bridging the gap lies on a bed of granulation tissue.

is in brief as follows: A vertical incision is made to the left of the trachea and the œsophagus is exposed by retraction of the musculature and great vessels. The vagi are stripped free, the branches going into the segment to be resected being sacrificed. The desired portion of the œsophagus being thoroughly isolated, gauze packings are placed beneath it, the ends coming out of the wound. The latter is left wide open. At the second stage, one week later, the isolated portion of the œsophagus is elevated by traction on the packings and is divided obliquely above and below. The packings and the segment of œsophagus are then removed. A bed of granulation tissue is found to have formed beneath the packings. A soft rubber tube of the diameter of the œsophagus is securely sutured to the upper and lower ends of the organ by stitches passed transversely. The rubber tube has a lateral opening in order to feed the animal by a catheter passed through it into the stomach. When the tube becomes loose it is removed if it has not already been discharged from the wound.

By this time the external wound is largely closed by granulation tissue. An œsophageal fistula, or rather a fistula through the new formed granulation tube, persists but finally closes completely.

Three experiments illustrate the process of gradual reconstruction of the œsophagus by the granulation tube operation and their description indicates the results that have been obtained.

At the end of one week the ends of the resected œsophagus are partly attached to a gutter of granulation tissue. Upon microscopic examination there is beginning union between the cut ends of the œsophagus and the adjacent, partly formed granulation tube, the first stage of epithelial overgrowth extending from the œsophageal epithelium.

Experiment 2. Dog 1965. Weight 11 kilograms. *Operation, first stage, April 1, 1921.* An incision was made to the left of the trachea, from the lower margin of the sternomastoid muscle, upward along its anterior border, to the lower pole of the thyroid gland. The sternomastoid was retracted laterally; vessels identified, isolated and retracted. The œsophagus was found behind and a little to the left of the trachea. The left vagus nerve was carefully freed and retracted with the vessels, those branches to the œsophagus being sacrificed over the portion to be isolated. Two and one-half inches of œsophagus were isolated, surrounded by wet packings, and the wound left wide open. April 1 to April 8, dog was given normal diet by mouth.

Second stage, April 8. Weight, 10.5 kilograms. Granulations were red and healthy. The œsophagus was drawn out of the wound by means of the packings, and the packings were removed. The upper limit of the isolated area was cut across obliquely, with the dorsal wall of the organ longer than the ventral. A soft rubber tube was inserted into the upper cut

end, and the edges of the œsophagus sutured to it, taking four sutures, one behind, one in front, and two laterally. These sutures were passed transversely, and the knots were tied on the outside. With the upper junction of tube and cut œsophagus now secure, the œsophagus was cut across below and the lower end of the tube sutured here in a similar manner. About 2 inches of the œsophagus were removed. A window was cut into the tube for feeding purposes. The wound was left wide open.

April 11. Dog has pulled tube out. Œsophageal ends found and another tube inserted and sutured in place. Feedings through an opening in it are to be continued.

April 13. Tube has become loose again; left out. The lower end of the resected œsophagus can be seen glued down firmly to the surrounding granulation tissue. The upper end is not yet attached. Feedings to take place through the œsophageal fistula, through which a catheter can easily be passed into œsophagus, thence into the stomach.

April 15. Since yesterday the animal has been vomiting and breathing with difficulty. Death.

Autopsy. Infection of wound is limited to site of operation. The lower cut end is firmly glued down to the granulation tissue, and it appears that the posterior wall of the granulation tube which has replaced the œsophageal defect is lined with epithelium; its color is light pink and has a glistening appearance, resembling the normal œsophageal mucosa. The upper cut end is not yet glued down to the granulation tissue around it.

Death was due to operation which was performed during pregnancy.

Microscopic sections. Sections taken through the junction of the œsophageal cut ends and the granulation tube show an abrupt ending of the œsophageal wall as indicated on the surface by a dipping down and a heaping up of the epithelium. At this site there is a termination of the mucous glands and the muscularis ends by intertwining with the adjacent tissue. This latter is granulation tissue presenting the earlier stages of organization, with here and there islands and groups of polynuclear cells. Toward the free surface, vascularization is more marked; there are many new-formed blood vessels. The surface is covered in part by an extension of epithelium continuous with the œsophageal epithelium. This new-formed epithelium, however, presents the following differences from normal œsophageal epithelium: (1) there are no papillæ; (2) it is not as thick; (3) it stains more deeply; (4) flattened surface cells of normal œsophageal mucous membrane are not present; (5) nuclei of cells are round throughout; (6) very active mitoses are present; (7) there is some polynuclear infiltration.

Three weeks after operation the granulation tube is solidly formed, with some distortion because the external fistula through the same still persists. The union between the divided ends of the œsophagus and the granulation tube is firm, and there is a more extensive epithelial overgrowth arising from the œsophageal epithelium.

Experiment 3. Dog 1809. *Operation, first stage, February 11, 1921.* Typical Witzel gastrostomy done through a left upper rectus incision. Five centimeters of cervical œsophagus were isolated by the usual technique, as already described. Packings were placed around the œsophagus and wound left wide open.

February 11–18. A tube has been inserted into the gastrostomy opening for feedings only. Six ounces of milk were given twice a day and 7 ounces of water four times a day; moderate emaciation; animal in satisfactory condition except for diarrhœal stools.

Second stage, February 18. Resection of 3 centimeters of cervical œsophagus, with insertion of tube, in usual manner.

February 23. Tube has disappeared from wound; apparently in the stomach.

February 25. Condition of dog is satisfactory. Œsophageal fistula, about 2 centimeters long, is present. It seems that the defect has been bridged by granulation tissue. Dog to be given water by mouth.

March 1. Gastrostomy permitted to close. Rubber tube is in stomach, as shown by X-ray picture.

March 10. For the past 2 weeks the dog has been taking fluids by mouth. Most of it passes into the stomach, about 5 per cent escaping through the fistula in the neck. However, in a few minutes after swallowing food, it is regurgitated and escapes either through the fistula or is vomited.

Autopsy, March 11. There is no infection of the wound. Œsophageal defect is occupied by a thin, pinkish-white tube of tissue, loosely attached to the surrounding musculature and the trachea. There is gradual merging of normal œsophageal wall into the tissue occupying the defect. The interior appears to be lined by a smooth layer continuous with the œsophageal lining. The new-formed tube, showing no stenosis, is about 4 centimeters long and of about the same diameter as the œsophagus.

Microscopic section. The termination of the œsophagus is indicated on the surface by a slight dipping in of the epithelium; it is only marked definitely by the ending of the mucous glands in the depths. The musculature grades into the tissue that occupies the defect, well beyond the termination of the mucous glands, thinning out gradually, and becoming ultimately intertwined with the young fibrous tissue. The new-formed epithelium is similar in appearance to the old, being of about the same thickness. Papillæ are now well developed, the staining appearance is almost identical with that of the normal, and there is developed a subepithelial layer of tissue similar to the submucosa of the œsophagus, with very little leucocytic infiltration.

For the rest, the tissue occupying the defect is of about the same thickness as the œsophageal wall, and presents granulation tissue with considerable organization and many new-formed blood vessels. Sections from the upper and lower junction of the œsophagus with the new-formed tube, when taken together, present the evidence that there has been considerable growth of epithelium over the granulation tube. The middle portion, however, remains uncovered by epithelium and presents heaped-up masses of polynuclear cells on the free surface of the granulation tissue.

A dog kept for 7 months after œsophageal reconstruction by a granulation tube was in satisfactory physical condition during that period. After an early stage of disturbed deglutition accompanied by repeated regurgitation of food, this animal was able to swallow fluids and mush, but no large fragments of food. A stenosis of the œsophagus at the site of the granulation tube was noted, and it was apparent that this could have been dilated by bougies. However, dilatation was not practiced because we wished to learn if the stenosis would be progressive, and thus vitiate the operative procedure. The stenosis remained stationary and was found at autopsy to have resulted in the reduction of the normal circumference by about one-fourth. Furthermore, the autopsy showed that the œsophageal ends had been drawn toward each other, reducing the original defect of 5 centimeters by about one-half. The lining by overgrowing epithelium was complete and the new-formed "œsophageal tube" was of the same thickness and of greater resistance to hydrostatic pressure than the adjacent œsophageal wall.

Experiment 4. Dog 1929. Weight, 15 kilograms. *Operation, first stage, March 18, 1921.* Isolation of 7 centimeters of cervical œsophagus by usual technique.

Second stage, March 25. Resection of 5 centimeters of œsophagus. The tube was sutured in place in usual manner.

April 1. Weight, 14 kilograms. Animal in good condition; has been taking feedings of milk and glucose water well. Does not regurgitate.

April 8. Three days ago the tube became loose and slipped into the stomach. The œsophagus was probed but the tube could not be felt. An exploratory laparotomy did not reveal the tube in the stomach or intestines; evidently it has been passed per rectum.

April 15. Weight, 12 kilograms. For the past few days the dog has been vomiting his milk. The milk is kept down for a short time and is then regurgitated. Soup and finely divided pieces of meat were tried with no better result. The dog swallows the meat, but it is caught in an œsophageal dilatation, due probably to a lack of nervous innervation. In a few minutes the meat and soup are vomited, some coming through the fistula, but most of the mixture coming out of the mouth. After repeated swallowings and acts of vomiting, the food remains in the stomach. Holding the animal up on his hind legs does not seem to aid in keeping the food down. Feedings through the fistula are to be discontinued; dog is to get meat, soup, milk and glucose water by mouth only.

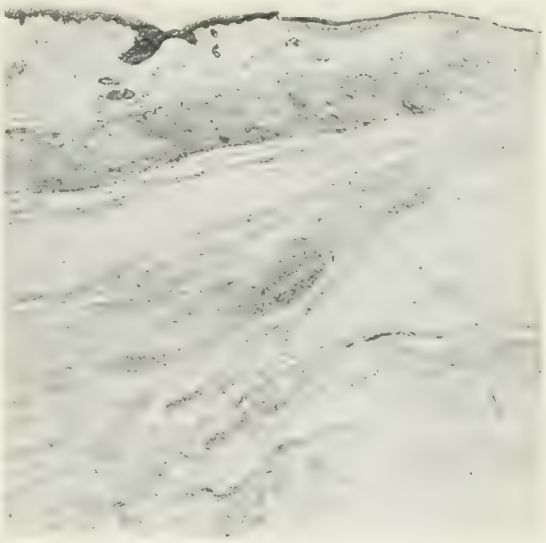

Fig. 3. Junction of normal œsophagus and replacement tissue at the end of one week. Low power drawing, showing abrupt ending of normal epithelium indicated by heaping of cells. The newly formed epithelium begins at this point.

April 22. Weight, 10.75 kilograms. Dog is in fair condition, although he still regurgitates food. A No. 20 bougie, when passed, meets an obstruction at the region of the fistula and passes it readily.

May 11. The general condition of the dog is good. He is very active, and runs around normally. Fluids are kept down better. *Œsophagoscopy* by Doctor Yankauer shows a stenosis at the site of the new-formed tube.

May 27. Weight, 10.75 kilograms. The fistula is closed. A No. 20 bougie meets an obstruction at this region but passes it easily. The stricture is apparently being gradually dilated by the passage of food.

October 17. Weight, 9.5 kilograms. During the summer the condition of the dog has been good. Regurgitation of food has gradually become less, although it still occurs.

Chloroformed.

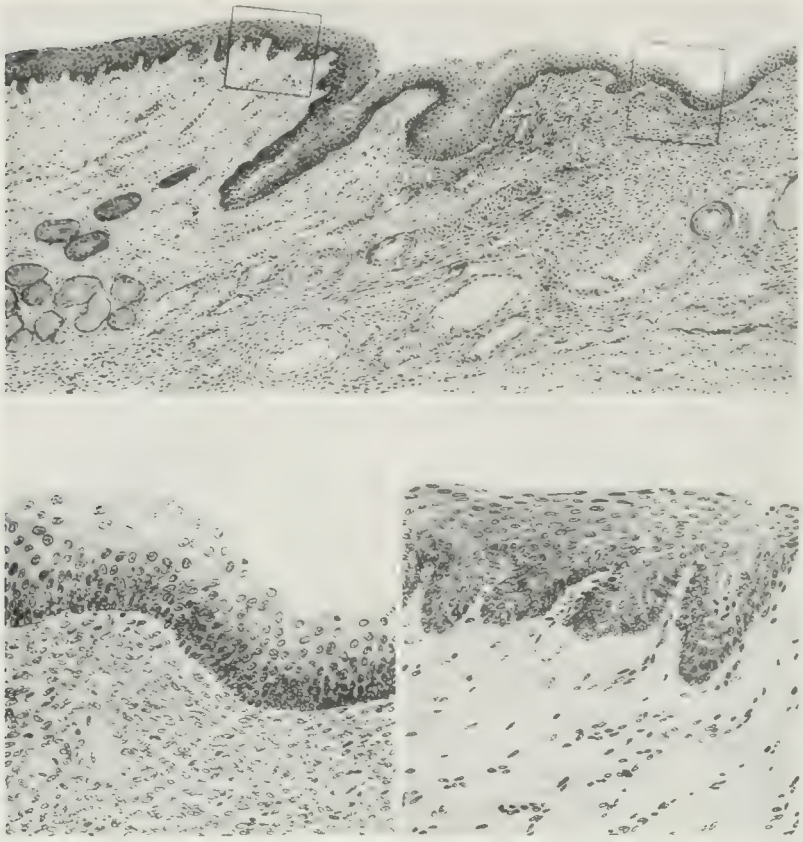

Fig. 4 (above). Medium power drawing of junction at the end of one week, showing ending of mucous glands and the differences between the normal and newly formed epithelium.

Fig. 5 (below, left). High power drawing of normal œsophageal epithelium at site of first square above.

Fig. 6 (below, right). High power drawing of newly formed epithelium at site of second square. There are no papillæ, no flattened cells at surface. The nuclei are round throughout, active mitosis and leucocytic infiltration in submucosa.

Autopsy. In the region of the operation, thin fibrous tissue loosely binds the œsophagus to the surrounding structures. There is considerable dilatation of the œsophagus above the reconstructed tube; the latter is narrowed by about one-fourth the lumen of the normal œsophagus. The new-formed portion is 4 to 5 centimeters in the fresh state as represented by whitish tissue different in color from the normal pinkish œsophagus. It is of the same thickness as the normal œsophagus, and when viewed from the inside a smooth, glistening lining completely covers the surface, bridging the area from normal œsophagus above to normal œsophagus below. Very fine blood vessels may be seen coursing from normal mucosa to the regenerated mucosa.

With the specimen removed, active peristaltic waves starting from the dilated portion proceed across the reconstructed tube to normal œsophagus below; active retroperistalsis passes in similar fashion. At times it seems as if the peristaltic wave skips the new-formed tissue; at other times a definite contraction through it is observed. This peristaltic action lasted for over an hour, in the isolated specimen, without immersing it in any physiological fluid medium.

Microscopic. Sections taken through the area of reconstruction show, on the surface, epithelium which has regenerated completely, there being no tissue left uncovered by epithelium. The new epithelium is similar to normal epithelium with perhaps the slight difference of more highly developed papillæ. The defect is occupied by fine-meshed fibrous tissue, which toward the surface resembles submucosa, and in the depths is a connective tissue rich in blood vessels. The tissue comprising the defect is as thick as normal œsophagus above and below.

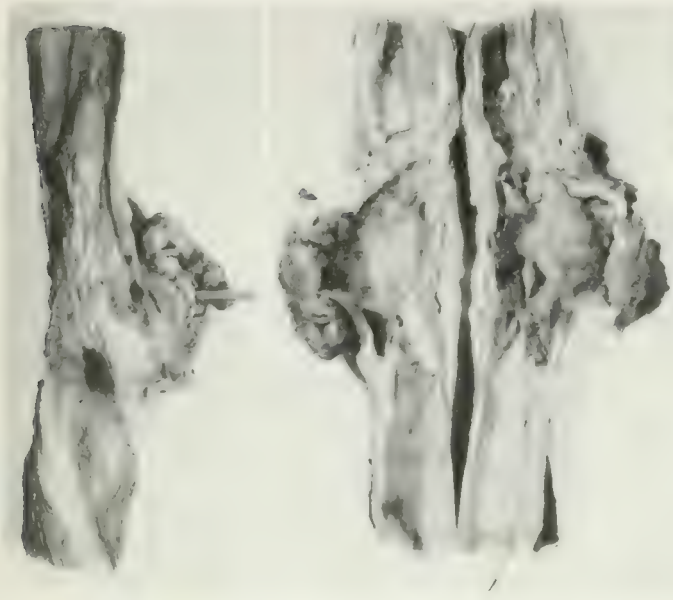

Fig. 7.

Fig. 8.

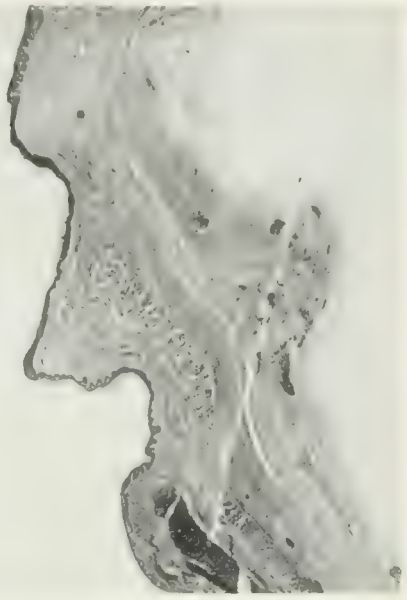

Fig. 9.

Fig. 7. Granulation tube occupying defect. Three weeks after operation. Newly formed tube is of a lighter color than normal œsophagus. Stylet indicates fistula leading into neck.

Fig. 8. Same as Figure 7, opened up, showing granulation tissue bridging gap between normal œsophagus above and below.

Fig. 9. Photomicrograph of junction of normal œsophagus and newly formed tissue, three weeks after operation. Section indicates ending of mucous glands. Musculature intertwines with the newly formed fibrous tissue. Regenerated epithelium very similar to the normal, with well developed papillæ.

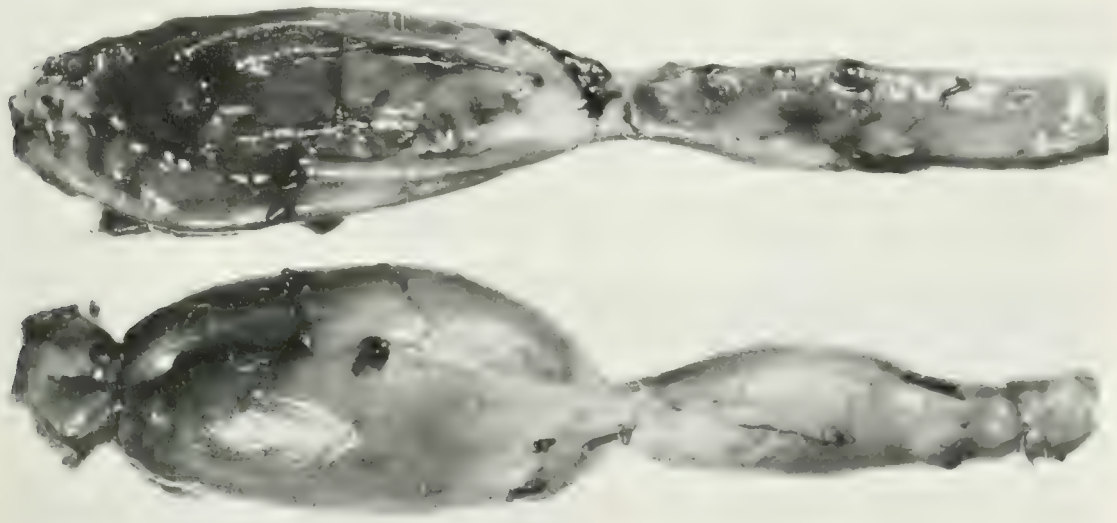

Fig. 10 (above). Specimen of œsophagus and newly formed tube 7 months after operation. Stricture narrowing lumen by one-fourth normal diameter is shown, with dilatation above.

Fig. 11. Same specimen filled with water, bringing out in contrast site of stricture which corresponds to that of the former œsophageal fistula.

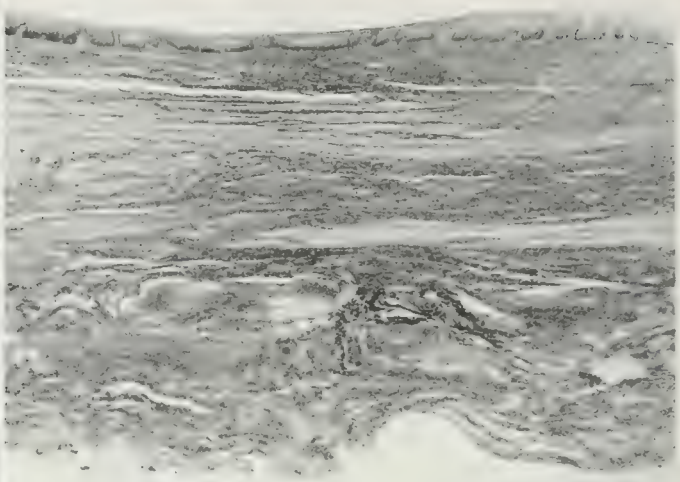

Fig. 12 (at left). Specimen opened up. Contraction of musculature; reconstructed area different in color from that of adjacent œsophageal wall.

Fig. 13. Photomicrograph showing the reconstructed area continuous with normal œsophagus. The newly formed epithelium is similar to normal epithelium. Junction point is indicated by ending and intertwining of muscle bundles. The thickness of the newly formed œsophageal wall is the same as that of the adjacent œsophagus.

As far as the actual reconstruction of the œsophagus by a granulation tube is concerned, we believe the difficulty would not be as great in the human being as in the animal experiments. In the latter there was always the problem of controlling the animal and of retaining the implanted tube for the desired period. It proved impossible to prevent the swallowing of all sorts of septic material even in the presence of a gastrostomy, dressings could not be kept in place, etc. The technique, as we believe it to be applicable to the human being, may be described as follows: Following gastrostomy, the first stage of the operation would be the exposure of the cancer of the thoracic œsophagus through the posterior mediastinum by the extrapleural approach as described by Lilienthal. An operable condition being found, the portion of the œsophagus bearing the tumor is isolated from surrounding structures, including the vagi, the branches entering the neoplasm being sacrificed. The isolated segment is surrounded by a sling of rubber dam on the outside of which packings are placed. The wound is left open in large part or completely. Superficial packings are changed when necessary, but deep packings are left undisturbed unless there is evidence of infection in the wound. It may be mentioned in passing that mediastinal suppuration can be present without clinical evidence, for in a case in the experience of one of us (H. N.) in which the above described first stage operation was done, a walled-off collection of pus in the mediastinum was unexpectedly encountered at the second stage operation performed one week after the isolation of a cancer of the thoracic œsophagus. At the second stage operation, the section of the œsophagus would be drawn toward the surface of the wound by traction on the rubber dam. The œsophagus would be divided above and below the neoplasm, not straight across but obliquely with the idea of reducing stenosis of the divided ends. A soft rubber tube would be chosen with a diameter of the filled œsophagus. One end of a long strand of silk would be fastened to the tube, the other end being brought out of the mouth and strapped to the cheek. The rubber tube would extend about 4 centimeters up and down into the œsophageal ends, and fixed to the wall of the œsophagus by sutures of

chromic gut passed transversely to œsophageal axis, with knots tied on the outside. Packings would be loosely placed about the rubber tube and the wound would either be partly sutured or left wide open.

This technique of rubber tube implantation would appear to be applicable only to œsophageal resection below the level of the arch of the aorta, and would probably have to be modified for tumors opposite or directly above the arch. In a patient operated upon by one of us (H. N.) in whom the neoplasm lay directly above the arch, the tumor-bearing portion of the œsophagus was isolated and the œsophagus stripped free up to the root of the neck. It was then divided below the neoplasm and a rubber tube sutured in place. The wound was packed with gauze and left open. The patient died of hæmorrhage from an intercostal artery 9 days after the first stage operation. It was planned at the second stage to expose the œsophagus in the neck, draw the tumor-bearing portion into the cervical wound, divide the œsophagus above the growth here, draw rubber tube into neck and suture it to the upper œsophageal stump.

Clinical experience will, of course, be necessary to determine if results similar to those noted in the animal experiments can be obtained, and whether a one- or two-stage operation will be required. From our studies, however, we believe it justifiable to advocate the reconstruction of short œsophageal defects such as those encountered in resection for cancer, by the granulation tube method we have devised.

SUMMARY

A simple experimental method has been devised in which a granulation tube is employed for the reconstruction of the œsophagus after its resection.

Fatal mediastinal infection follows its attempt in one stage.

The two-stage operation is successful. In the first stage the section of œsophagus to be removed is isolated and in the second stage it is resected and a rubber tube is implanted.

A granulation tube forms with epithelial overgrowth from the œsophageal ends beginning in one week and becoming extensive at the end of 3 weeks.

The longest period of observation was 7 months after operation. In this case the new-formed tube was well developed and completely lined by œsophageal epithelium. A partial stenosis appeared soon after operation but was not progressive.

The method is advocated as applicable for reconstruction of the œsophagus after resection for cancer.

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TOTAL REMOVAL OF THE SCAPULA FOR PRIMARY GIANT-CELL SARCOMA

By BYRON B. DAVIS, A.B., M.D., F.A.C.S., Omaha, Nebraska

COMPLETE excision of the scapula was first done in 1855, by Langenbeck. The chief indication for the operation is sarcoma, and, since this neoplasm rarely occurs primarily in the scapula, the number of excisions has been few. As regards the rare incidence of sarcoma of the scapula, the figures of Coley are illuminating. In 1910, he reported 251 cases of bone sarcoma that had come under his observation, distributed as follows:

Femur	117
Humerus	54
Tibia	40
Fibula	8
Radius	12
Ulna	7
Clavicle	11
Metacarpal	2

His list does not contain a single instance of sarcoma of the scapula. John B. Murphy, in 1915, showed a case in his clinic of sarcoma of the scapula, for which he did a total excision; and at the time he gave the distribution of 797 cases of bone sarcoma, as follows:

Head	23
Jaw	227
Thorax	20
Scapula	23
Clavicle	3
Humerus	90
Radius	90
Ulna	15
Hand	19
Ilium	17
Sacrum	6
Femur	100
Tibia	100
Fibula	25
Foot	29

This table gives only 23 cases of sarcoma of the scapula in 797 cases of bone sarcoma, making its incidence a little less than three-tenths of one per cent.

For his inaugural address as president of the American Surgical Society, in 1909, Nancrede chose for his subject, "End-Results after Total Excision of the Scapula for Sarcoma." All the cases he could find records of, at this time, in the world's literature, were 65, and of the whole number, only 1 was nearly certainly cured. In the face of this appalling mortality, Nancrede concluded that, in the future, he would recommend intercostohumeral amputation in preference to total removal of the scapula.

Fowler, in his *Treatise on Surgery*, says that in a fortunately early case of sarcoma of the scapula, there is a possibility of a successful excision "but the instances must be few and far between in which such a course would not be followed by recurrence."

September 5, 1921, Mrs. F. C., age 27, consulted me for an enlargement of the left shoulder blade. She gave the following history:

She has had measles, small pox, and whooping cough. Otherwise she has always been well except for her present trouble. September 9, 1919, while trying to raise herself upon a log, her left hand slipped, and she felt a sharp pain in the left shoulder. She is certain that she did not strike her shoulder against any object. For about a month after this occurrence, when exercising her arm, she experienced pain over the left scapula. At the end of a month this pain disappeared and she noticed nothing more until August, 1920, when, after swimming for a long time, she felt some aching in the region of the left scapula. She was married in October, 1920, and, after this, when doing housework, she noticed, at times, pain over the scapula.

While going down the cellar stairs, December 22, 1920, she tripped and threw out the left arm to catch herself, and there was a sudden sharp pain in her left shoulder blade. The pain lasted about 5 minutes. The pain immediately subsided, and she forgot all about it until 6 days later, while visiting in Creston, Iowa, she noticed in the mirror, while raising her left arm, an oval swelling about the position of the body of the scapula. This swelling she described as about 2 inches long and 1½ inches wide. She consulted a doctor, who told her she had a fracture of the left scapula, but gave her no treatment. During the next few weeks, the swelling extended more posteriorly. From this time on she had occasional pain when she moved her arm vigorously.

At Easter, in 1921, she burned her finger and jerked her arm away, and there was severe pain over the scapula for a few minutes and soon it

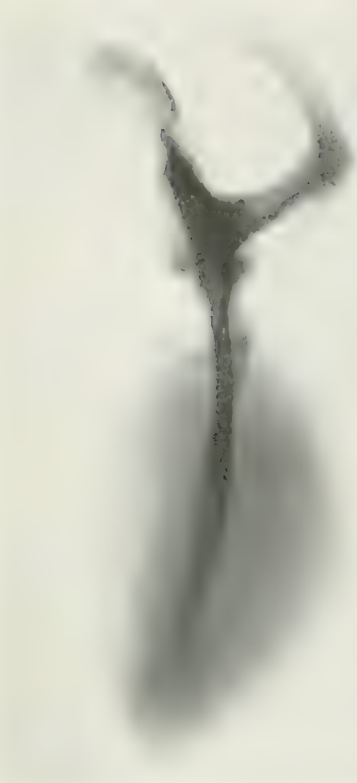

Fig. 1. Roentgenogram showing tumor of the scapula.

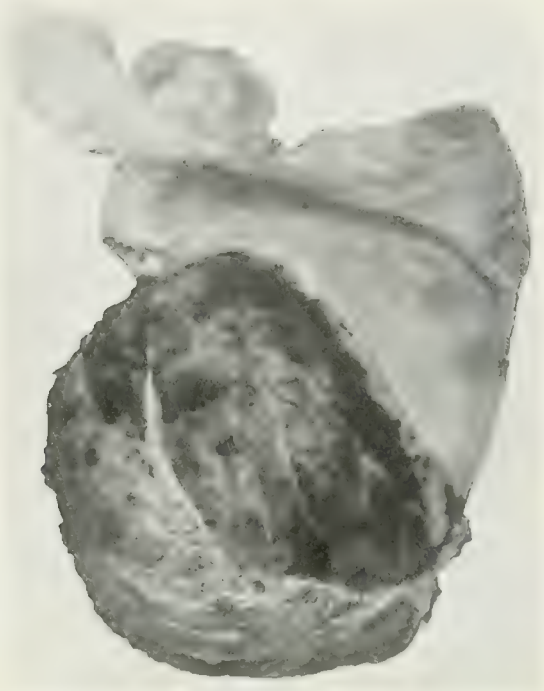

Fig. 2. Gross specimen of tumor of the scapula.

became more swollen. She consulted a physician in Lincoln, Nebraska, who told her to paint iodine over the swelling. Under this treatment she says the mass diminished in size considerably, but in about a month she found it was growing again.

In June, 1921, a roentgenogram was taken and she was again told she had a fracture of the scapula. Since Easter there has been pain over the scapula whenever she uses her arm.

In August, 1921, she consulted a surgeon, another X-ray was taken, and the diagnosis of sarcoma of the scapula was made for the first time.

My physical findings at this time were as follows: The body of the scapula is very much enlarged and rounded, making it very prominent, the mass being at least 3 inches, possibly 4, in thickness. The skin is movable over the mass, and the scapula is freely movable over the chest wall. The mass is only fairly firm in consistency and crackles slightly when pressed. The range of motion of the arm is only slightly limited. There are a few superficial dilated veins, coursing over the tumor. The X-ray indicated a sarcoma of the body extending up along the anterior border to, but apparently not including, the glenoid cavity. Clinical diagnosis: sarcoma of the body of the left scapula. Removal of the scapula was advised and she entered Immanuel Hospital, September 9, 1921.

Operation, September 12, 1921. Drs. Herbert Davis, O. E. Olson, and E. K. Eskildsen assisted, and Dr. J. S. McAvin gave gas and ether. An incision was made from the inner border of the axilla outward along the course of the coracobrachialis muscle. The axilla was opened, its anterior fold retracted forward, and the tip of the coracoid process reached with the finger. The pectoralis minor muscle was hooked up and cut with scissors. Next, the coracobrachialis was pulled up with the retractor and cut, after which the short head of the biceps was raised on the retractor and cut, all of them at a considerable distance from their attachment to the coracoid process. The subscapular artery and vein were made easily accessible and were ligated doubly and cut between, and the axillary wound packed with gauze.

To make the field of operation accessible for the next step the patient was turned on her right side. An incision was made from the superior angle of the scapula, along the vertebral border to the lower

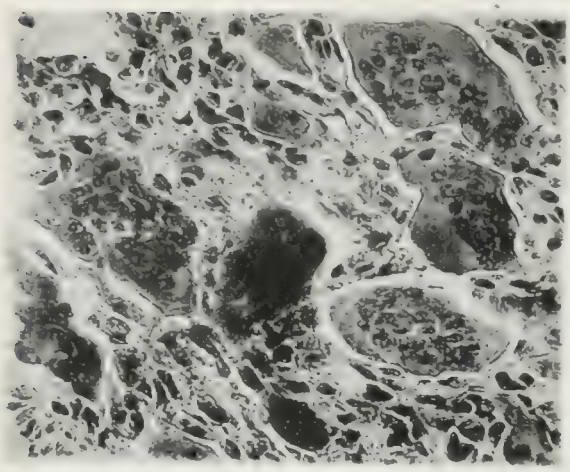

Fig. 3. Photomicrograph of section of tumor removed.

angle. Another incision was carried from the tip of the acromion process along the spine of the scapula until it met the first incision. The skin flaps thus formed were dissected up sufficiently to uncover an area corresponding to the scapula. The trapezius muscle was now cut away from its attachment to the scapula at a short distance from the bone. Next, the minor and major rhomboids were severed, also at a little distance from the vertebral border of the bone. The latissimus dorsi was found to be attached to the lower angle by a few fibers, which were divided, and following up the anterior border, the teres major and minor muscles were both cut. The finger was next inserted underneath the flat serratus magnus and the entire muscle was cut just before it passed behind the external border of the subscapular muscle.

The lower angle of the scapula was then raised from the thoracic wall and everything loosened from behind; then, passing upward, the levator anguli scapulæ and the omohyoid muscles were cut. At this point both the descending branch of the transversus colli and the transverse scapular arteries were cut and tied. The deltoid was now separated from all its scapular attachments and the acromion process was disarticulated from the clavicle. The humeroscapular joint was then opened, and the humerus separated from the glenoid cavity. The long head of the biceps and the long head of the triceps were divided, after which the coracoid process was freed from what attachments remained.

After tying all the bleeding points a running suture of catgut was used to gather a mass of muscles about the head of the humerus in such a way as to form a muscular pocket. The skin wounds were closed with dermal stitch and a small rubber drainage tube was inserted at the meeting point of the two skin incisions.

The patient was turned on her back and the axillary wound closed, leaving a small rubber drainage tube. The wound was dressed, the elbow being kept abducted somewhat away from the chest wall.

There was some shock, from which patient had fully rallied within 6 hours. The muscles were all divided almost an inch away from their attachments to the scapula. As the operation proceeded, it was remarked how little trouble was experienced from hæmorrhage. Sir W. Watson Cheyne was the first to recommend preliminary ligation of the subscapular artery, and it seems an excellent procedure. The most difficult part of the operation as usually done is separation of the coracoid process; by dividing the three muscles attached to this process through the axillary wound the operation is much simplified.

September 18, the patient was able to brush her teeth, using the left hand to hold the tooth brush, and she sat up for the first time.

September 19. Sat up 2 hours during the forenoon and is feeling fine.

September 20. Combed and arranged her hair. She was encouraged to use the hand in every way possible, several times daily.

Discharged from hospital and recommended to exercise the arm as much as possible without discomfort.

The following statement was made by her in a letter written me November 30, 1921: "In regard to my arm I find it is still gaining in strength. I can take care of general housework, such as making beds, sweeping, dusting, ironing, sewing, dishwashing, etc. I find my hair-dressing is improving too. It is not such an effort for me to comb my hair now and the result is also much better. The grip of the left hand is as good as the right. People have told me here they had not noticed by appearance, or action that I did not have full use of my arm."

Pathological examination by J. Jay Keegan, M.D., from the pathological department of the University of Nebraska Medical College:

"Pathological examination of the tumor of the scapula of Mrs. C. showed a rounded tumor mass involving almost all of the axillary border below the glenoid fossa, the inferior angle, and extending along the vertebral border a distance of 1½ inches. The weight of the entire specimen including muscles was 805 grams, with muscles removed 425 grams. The tumor mass measured 4 inches in length, 3½ inches in width and 3 inches in depth, being flattened against the chest wall. Its consistency was soft, almost fluctuant in the center, with a few spicules of bone palpable. It was enclosed in a definite capsule except at the inferior angle and below the glenoid fossa, where reddish granular tumor tissues appeared.

Fig. 4. Photograph of patient after operation showing scar and patient's ability to raise hand above head.

"Microscopic examination of one of these granular areas showed a very characteristic giant-cell sarcoma. Three types of cells were present: a stroma of elongated spindle cells resembling fibrous tissue, this enclosing areas of larger fusiform cells and multinuclear giant cells. The operative removal was sufficiently wide so that no tumor tissue was incised. This type of tumor is considered relatively non-malignant as it rarely metastasizes and complete removal usually results in a cure. The only questionable areas were two places where the tumor appeared to have broken through the capsule."

As far as it has been possible to ascertain in a rather extensive search of the literature, this is the first case of unquestioned giant-cell sarcoma of the scapula yet reported. I am free to admit that before the case was operated upon, it was not certain what type of sarcoma we had to deal with, though, from the history and the rather slow development, it was felt there was good ground for considering it a mildly malignant growth and entertaining a lively hope that it was a giant-cell tumor.

It is, I believe, to Nélaton, that we are indebted for first fully establishing the benign course of giant-cell sarcoma, and the good results of conservative treatment. But the careful observations of Bloodgood andthe fearlessness with which he has put the conservative treatment of this class of cases on a workable basis have done much to standardize our knowledge. The last report of his I have been able to obtain gives 47 cases of benign giant-cell tumors in which the ordinary features of malignancy were absent.

Coley has been working on the same line, but in his 40 cases of giant-cell sarcoma, the diagnosis being confirmed by leading pathologists, 8 have died of metastases.

The gross appearance of these tumors is variously described as "reddish jelly-like tumor masses resembling granulation tissue," "rather soft and, on section, resembles splenic tissue, or even currant jelly." They pulsate and even after they have absorbed the bone and broken through in places, the true giant-cell tumor shows no disposition to infiltrate the soft tissues.

Histologically this species of sarcoma consists of giant-cells so numerous and so uniformly distributed as to give a characteristic appearance under the microscope.

These giant multinuclear cells are not the sole cellular elements of which the tumor consists. There are also round or spindle cells grouped around the giant cells, which vary in size and shape. They are usually round or oval, sometimes having a uniform margin and sometimes being very much broken in outline, with protoplasmic masses extending out from the main body of the cell.

Several surgeons and pathologists, notably Bloodgood, Coley, and Platou take the position that these giant-cell tumors are always permanently benign and that it is entirely justifiable to treat them conservatively by curetting out the soft tumor-tissue mass, or doing a conservative resection of the bone, or, if very extensive, an amputation may rarely be required. Others are not so certain. Ashhurst seems to take the ground that, although the real giant-cell sarcoma does not metastasize, it may occasionally undergo sarcomatous change, when it begins to grow rapidly and recurrence is usual. Even Ewing, who holds to the benign character of giant-cell sarcoma, admits that as the spindle cells of the stroma become more active and abundant, the giant cells diminish, the resemblance to granulation tissue is less in evidence, and the tumor comes more and more to resemble a spindle-cell sarcoma. When this point is reached, local recurrence, destruction of bone, and infiltration of soft tissue occur, but Ewing has never known such growths to metastasize.

The exact line of separation between the entirely benign giant-cell tumor and the sarcoma with a superabundance of giant cells, which does infiltrate, which does form metastases, seems yet somewhat imaginary, and there seems to be some danger of ultra-conservative treatment being carried too far.

STREPTOCOCCUS SCROTAL AND PENILE GANGRENE[1]

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Resident Urologist, Bellevue Hospital

ACUTE fulminating gangrene of the scrotum and penis is a disease characterized by an abrupt, spontaneous onset, a rapidly ensuing inflammation with marked œdema, and subsequent necrosis of the superficial tissues of the genitals. The condition is usually accompanied by generalized sepsis and prostration. In private practice the disease is rarely, if ever, encountered. Indeed it is rarely seen except among patients of the large city hospitals. Physical debility associated with a variable degree of bodily filth is more frequent in patients of these institutions and may, in a measure, bear relationship to the occurrence of the disease. During the past 6 months, we have observed clinically and studied bacteriologically 5 cases admitted to the Urological Service of Bellevue Hospital. These investigations revealed a streptococcus hæmolyticus in each instance as the probable causative agent. This finding substantiated by the clinical picture leads us to believe that the disease is closely akin to the syndrome of erysipelas.

CLINICAL FINDINGS

A spontaneous, extensive tumefaction of the scrotum and penis occurs. Frequently these may become three, four, and even five times normal size. The involved parts are exquisitely painful, hot, and the skin is tense, shining, and sensitive. Redness may extend to the lower abdominal wall. There is, however, no sharp line of demarcation. Considerable œdema soon develops. Within the next 36 to 72 hours the glazed skin becomes a dull red, a superficial watery exudate appears, and in the more dependent portions there is the brownish or greenish tinge of early gangrene. This gangrenous process may often begin in several places simultaneously, especially on the lower parts of the scrotum or on the pre-

[1] From the Urological Service, Bellevue Hospital.

puce and skin immediately behind. It spreads rapidly toward the groin rather than toward the perineum, a characteristic distinguishing it from the gangrene of so-called urinary extravasation.

Soon, as in other types of gangrene, a line of demarcation is established beyond which the process will not extend. The gangrenous areas, if multiple, coalesce to form one gangrenous mass. Two of our cases (4, 5) are unusual in that the infection extended posteriorly to both ischiorectal fossæ with a necrosis of all the superficial perineal tissues. The patient is likely to die before the gangrene extends upward beyond the pubic region though it may reach the umbilicus. Involvement of the penis does not extend beneath the sheath of the corpora cavernosa. Involvement of the testicles and cord is limited by the sheath and tunica vaginalis. Sloughing of the testicle does not occur. In two of our series (1, 4) there was partial sloughing of the tunica vaginalis. The skin of the thighs is singularly exempt from involvement. In neglected cases, during the 4 or 5 days succeeding onset, the definitely demarcated, sloughing, gangrenous mass, emitting the characteristic stench of decaying flesh, separates. Removal of the scrotal tissues by necrosis or the knife leaves the testicles dangling unprotected between the thighs. Some have noted crepitation of the tissues; we have not. The condition is in no sense a venereal disease and is accompanied by no urinary disturbances.

SYMPTOMS

Many writers have remarked of the sudden onset of systemic symptoms—chills, fever, nausea, vomiting, prostration, and delirium. While some of our patients were septic, in the others the contrast between the excellent general condition and the intense local reaction was most striking. An acute fulminating onset—designated "explosion" by Fournier—with a rapidly ensuing moist gangrene of the involved tissues, appearing spontaneously, has characterized our series of cases. It was not at the onset that our patients manifested symptoms of toxæmia but rather after the gangrenous process was evident—an absorption intoxication.

ETIOLOGY

Of paramount interest is the etiology and pathology of the disease. According to Whiting (1), the most probable predisposing factors to scrotal gangrene are (1) the laxity of the cellular tissue which permits marked infiltration and (2) the looseness of the skin which diminishes resistance to infection. Age apparently is no factor, the youngest case on record being 2 years old (Marcy); one of our patients was 71. Trauma has been considered by some but an analysis of case records shows it to be singularly lacking in most instances. It is possible that concomitant lesions as urethritis, bubo, phimosis, etc., may afford a portal of entry. One patient told of an intense penile itching, for relief of which he resorted to scratching with the fingernails. Soon thereafter, a malignant infection appeared, but it is reasonable to suppose the itching was an early manifestation of a highly virulent infection not yet grossly evident. It is conceivable that the organisms may be introduced by clothing friction.

BACTERIOLOGY

Clinically and pathologically the condition seems to be a cellulitis, the onset, manner of extension, the red, painful, hot, and œdematous nature of the lesion being characteristic of such a type infection. Most observers have felt that there must be a definite causative organism and consequently a number of bacteria have been accused as the etiological agent. Thus, the Klebs-Loeffler bacillus, the spirillum of Vincent's angina, an aerobic diplococcus, various anaerobic organisms, a pseudodiphtheria bacillus, bacillus aerobus septicus, bacillus aerogenes capsulatus, and the streptococcus have been arraigned. More recently a pseudo-Ducrey bacillus has been included. The wide variety of organisms mentioned is evidence of their undetermined relationship to the disease.

In all of our cases recently studied, direct smears were made through the cauterized skin surface before incision and all showed a long chain variety of streptococcus. In four

Fig. 1. Case 1. Partial denudation of testicles and penis, 5 days after operation.

of these cases the material so obtained was plated on blood agar and after 48 hours pure cultures of streptococcus hæmolyticus were obtained. In view of the constancy with which we encountered the organism and the association of erysipelas of the face and arm with the scrotal gangrene in one of our patients (the erysipelas succeeding the scrotal condition by 4 days with an admissible history of transmission to and inoculation of the face by the fingernails after having scratched the scrotal tissues) it seems entirely reasonable to suspect that this so-called idiopathic gangrene may be a cellulitis of the superficial tissues not unlike erysipelas.[1] A search of the literature reveals but 6 cases of scrotal erysipelas, the onset and course of the disease coinciding well with that of "idiopathic" gangrene,[2] all being followed by necrosis and sloughing of the involved parts. Finch (3) has reported an instance of scrotal erysipelas followed by gangrene as a result of infection produced in tapping a hydrocele. Such a sloughing gangrenous erysipelas of the penile skin occurred in the wards of the famous surgeon Nélaton following a trifling incision of the frenum. It seems reasonable, therefore, to consider these cases as intimately allied to erysipelas, if not typically the condition itself, the presence of the hæmolytic streptococcus of the streptococcus longus type being corroborative.

[1] Fehleisen (2) described an organism called by him the streptococcus erysipelatis believing the disease erysipelas to be a specific infection of this strain. At present, bacteriologists are not prone to accept this view. Most believe the disease may be produced by any of the streptococcus longus hæmolyticus variety, there being no streptococcus of erysipelas *per se*.

[2] So called by Randall, Alexander. J. Urol., 1921, iv, 219.

PATHOLOGY

Grossly, the penis and scrotum appear as previously described. On incision, the subcutaneous tissues are yellowish or brownish green color, depending upon the degree of necrosis, and are bathed in œdematous exudate, great quantities of fluid escaping as the tissue is sectioned. These tissues are somewhat friable and are easily torn or separated by finger dissection. It is noteworthy that the vessels everywhere show thrombosis, bleeding being encountered only when tissue relatively free from involvement is cut. The generalized thrombosis explains the gangrenous changes. Pus pockets are not uncommon beneath the penile skin, lying upon the sheath of the corpora cavernosa. In some instances, this burrowed up under the lower abdominal skin, this being tougher and more resistant to the invading process. In one instance, pus burrowed along the spermatic cord into the inguinal canal.

Microscopic examination of involved tissue reveals only areas of partial and complete necrosis. Polymorphonuclear infiltration is abundant throughout. The vessels show thrombosis.

DIFFERENTIAL DIAGNOSIS

The condition which most closely simulates this form of scrotal gangrene is that called urinary extravasation, a gangrene of scrotum and perineum secondary to periurethral suppuration and usually associated with stricture. If is it borne in mind that the urethral sclerosis does not necessarily obstruct the passage of instruments of moderate size, careful history and local examination will usually reveal the urethral origin of the extravasation while operation always discloses it. The absence of urinary symptoms, the free passage of urethral instruments to the bladder, and the sudden onset without cause should rule out extrava-

Fig. 2. Case 1. Appearance 5 weeks after operation. There is some distortion of the penis which, however, is not evident in the picture.

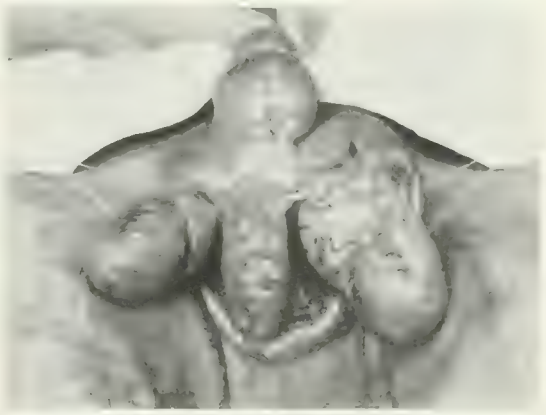

Fig. 3. Case 5. 5 days after excision of involved skin areas. Marked induration of the scrotal septum is to be noted, a portion of this structure having been removed.

sation. Acute periurethral abscess scarcely simulates scrotal gangrene, for it is not associated with gangrene. Passive œdema of the scrotum due to nephritis, cardiac insufficiency, hepatic cirrhosis, Asiatic cholera, smallpox, chronic alcoholism, diabetes, etc., may well be mistaken for streptococcus gangrene at first glance for the two conditions occur in patients of a similar type and the œdema may simulate the gangrenous process quite closely in its rapid onset and great swelling. We know of a case of œdema that was operated upon under the mistaken diagnosis of urinary extravasation. The gangrene of diabetes especially should be considered because of the striking clinical similarity of the two conditions.

PROGNOSIS

Whiting (1) collected 93 reported cases from the literature, of which number 23 died, a mortality of 23.5 per cent. Coenen and Przedborski (4) found 145 cases among which there was a mortality of 22.1 per cent. Of the 5 cases here reported, 1 died. A mortality of 20 to 25 per cent is therefore apparently to be expected. The prognosis seems to depend upon the severity of the toxæmia. The urine of two of our patients was studied several times, but showed no evidence of toxic albuminuria. In no case was sugar found. Emery (5) speaks of the "mode of termination of the disease by a cure" and in our series all recovered readily save one who developed metastatic erysipelas.

TREATMENT

The treatment is surgical. A review of the earlier therapy is most interesting. Apparently the entire pharmacopeal armamentarium was utilized: glycerin, belladonna, bichloride of mercury, various dusting powders, etc., were administered interchangeably. Once castration was the recognized procedure, a regeneration of the scrotal tissues being deemed impossible. So common was this procedure that a physician near Boston reported a case under the title "Gangrene of the Scrotum in Which the Testicles Were Not Removed." We now recognize that the testicles and their enveloping sheaths should be left intact. Some have questioned the wisdom of free and early incision. Such incision has been our routine procedure, thus permitting proper surgical drainage. If there is extensive involvement, whole masses of scrotal skin have been excised. If there is involvement of the penile skin, it too is removed as far back and extensively as seems indicated, since we are aware of the surprising regenerative powers of the skin of these parts. Anæsthesia is by no means always necessary, much of the involved tissue being insensitive. Hot potassium permanganate 1:500 applied continuously serves as

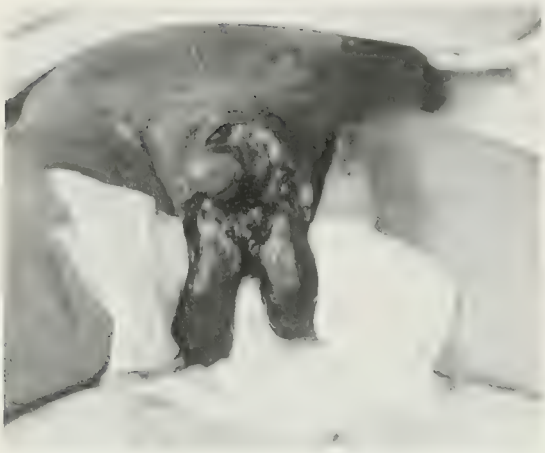

Fig. 4. Case 4. Picture taken 2 days after operation. This patient developed erysipelas of the face and right arm 3 days later. There was marked extension along the penis. Later the lower abdominal wall became gangrenous.

an antiseptic and deodorant. We employ it both as a dressing and irrigant.

As soon as the patient has recuperated sufficiently from the excision operation, he is given a daily bath for an hour in a tub of hot water. This has proven most beneficial, serving admirably to cleanse the wound thoroughly. Once the slough is removed, the rapidity with which the granulation tissue forms is astounding. Various plastic operations have been suggested, but if one will adhere to the rule of keeping the testicles well against the perineum, the scrotal tissue will be found to regenerate over them and operations will rarely be necessary. No plastic operations have thus far been necessary in our series. If there is much cicatrix formed about the base of the penis, there is of course danger of chronic œdema of the glans. A moderate œdema was noted in one case but has called for no treatment.

CASE REPORTS

Case 1. W. B., ticket agent, age 29 years, was admitted to the Urological Service, Bellevue Hospital, March 14, 1921, complaining of swelling and pain in the penis and scrotum. Duration 2 days. Onset sudden and rapidly progressive accompanied by chills, fever, and some prostration. Temperature on admission 103.5°. Gonorrhœa 15 years ago. No complications. No urinary disturbances. On admission penis was 6 times normal size, scrotum 4 times normal size and both red, glazed, tense,

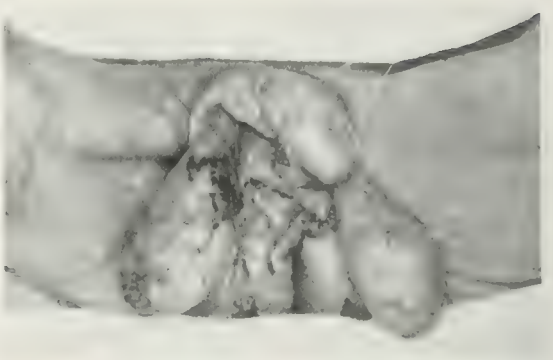

Fig. 5. Case 5. Three days after operation. The most unusual complication of extension to the buttocks with subsequent sloughing of the superficial perineal tissues is noteworthy.

œdematous, and exquisitely tender and painful. The penile skin was blackish in some parts, but that of the scrotum showed no evidence of gangrene. There was no perineal infiltration. Testicles and epididymes were not made out. Some induration of the groin. A No. 26 F. sound was passed easily to bladder. Under ½ per cent novocain a dorsal slit was made and prepuce retracted, it being thought at first that a prepucial lesion might be present. None was found. The next day the entire penile and scrotal skin was removed, under general anæsthetic, and permanganate dressings (1:500) applied. At operation, a partial necrosis of the right tunica vaginalis was noted and the greater part of the tunica was excised. Smears showed a great number of long chain streptococci but no culture was made on blood media.

During the succeeding week great quantities of slough separated and in 10 days fresh granulations were evident. Blood cultures taken the day following admission were sterile 48 hours after. The temperature oscillated about 103° for nearly a week and then came to normal, the signs of toxæmia gradually disappearing. The patient remained in the hospital 4 weeks at the end of which time scrotal and penile skin regeneration had progressed rapidly. There was, however, some distortion of the parts by the newly formed scar tissue.

Case 2. M. D., a street cleaner age 58, was admitted to Bellevue April 4, 1921. Complained of swelling and soreness of the penis. Three days previous to admission he noticed an itching of the distal portion and scratched the part. Rapidly the penis became red, hot, swollen, and tender. On admission the entire penis was about twice normal size, markedly inflamed, with gangrene and sloughing of the entire ventral half. On the dorsum there were three pea-sized areas of necrosis. The patient thought that these might have been caused by scratching. Smears showed a long chain streptococcus which when plated on blood agar caused hæmolysis. Venereal disease was denied. No urinary disturbances.

A dorsal slit was performed and the organ put in a wet dressing of permanganate 1:500 which was changed twice daily, considerable slough being removed with each dressing. Two weeks later patient was circumcised, such tags of tissue as remained being removed. He was discharged at the end of 3 weeks, wounds healing well, but had not returned since and has been lost sight of. On admission the temperature was 99°. The day after circumcision it rose to 102° falling the next day to normal and remained so throughout his stay in the hospital.

Case 3. J. K., a laborer, age 60, was admitted to Bellevue Hospital May 11, 1921, with pain and swelling of scrotum and penis. Onset was gradual 2 weeks previous to admission, with increasing redness, pain and swelling of the parts. No history of trauma or infection. No urinary disturbances. Examination revealed an acute inflammation of the penis and scrotum, the dependent portion of the latter being in early gangrene. No inguinal adenitis. The scrotal lesion was not sharply defined. Smears made by puncture through the cauterized skin showed long chain streptococci in great numbers. On blood agar, hæmolysis was produced. A No. 19 F. sound passed easily to the bladder, and prostate was found to be normal. Urine examination was negative. The next day under local anæsthesia, the entire scrotal sac with most of the scrotal septum (all found to be involved) was removed. Bleeding was stopped with hot permanganate dressings. On the left, pus was found to extend up the cord, stopping about an inch inside the external ring. At no time were the systemic symptoms of toxæmia marked, and within 48 hours after removal of the dead tissue, the patient felt improved. On admission the temperature was 101° but dropped to normal in 36 hours and remained so throughout the succeeding course of the disease. On discharge, 4 weeks later, the scrotal and penile skin was granulating over rapidly, the lesion being quite painless. When seen 2 months after discharge, the testicles were nearly covered with epithelium but there was moderate scarring about the base of the penis causing some chronic swelling and œdema of the glans. This condition caused no discomfort however.

Case 4. J. M., a porter, age 50, was seized with a sharp pain localized in the lower right quadrant shortly after a meal. He vomited several times, took a cathartic with good effect, and came to Bellevue Hospital May 19, 1921, 6 hours after onset. One day previous to admission he noticed a slight drop at the meatus and swelling of the left side of the scrotum. Venereal disease denied, no exposure except wife. Examination showed bilateral enlargement of the inguinal lymph glands with some tenderness. The next day the scrotum was found to be swollen and red, said to be "suspicious of erysipelas." The following day it was the size of a grapefruit and at the lower pole showed areas of early gangrene. The penis too showed involvement being acutely inflamed and twice normal size. There were no urinary difficulties and a No. 20 sound passed to the bladder without difficulty. On this date a direct smear through the cauterized skin was made and found to show streptococci in great numbers. On blood agar, these organisms produced hæmolysis. That afternoon (May 21, 1921) all the scrotal and penile skin showing involvement was excised under gas-oxygen anæsthesia, and hot permanganate 1:500 dressings applied. Incisions were carried posteriorly into the ischiorectal fossæ where large pus pockets were found. (Subsequently the perineal tissues sloughed away.) Because of collections of pus burrowing beneath the penile skin, practically all of this tissue was removed. On the left a small patch of gangrene of the tunica vaginalis was discovered. This was excised leaving the testicle naked. Three days later marked tenderness, redness, and œdema of the nose was noted, the lesion extending somewhat in butterfly design to the cheeks. The patient began to have pain about the mouth. The right elbow and upper arm also were red and œdematous, more especially the elbow. The margins were sharply defined and elevated. The patient gave a history of scratching his face and arm after having scratched the primarily involved tissues. On May 27, the skin over the lower abdomen was red and indurated. Permanganate dressings were applied. Much slough was removed from the scrotal lesions. That night the patient became irrational, tore off the dressings, and had to be restrained. Two days later the cellulitis of the arm was found to be extending whereas the erysipelas of the face was improving. That night patient died with signs of a grave toxæmia. A blood count showed 15,000 white cells, 92 per cent of which were polymorphonuclears. The temperature on admission was 104 and varied little during the course of the disease.

Case 5. A. F., a peddler, age 61, was admitted to Bellevue Hospital May 24, 1921, complaining of pain and swelling of the scrotum and penis. Venereal disease denied. The onset was rather sudden, 3 days before, when he noticed swelling, redness, and pain localized to the scrotum and penis, beginning first on the former. Rapidly these symptoms increased in severity but there was no marked systemic reaction. On the day of admission to the hospital, these organs were found to be about three times normal size, showing all the evidences of an acute inflammatory process with patches of gangrene at the lower pole of the scrotum. Near the prepuce two brownish areas of early gangrene were noted. The skin redness was in no sense demarcated. There was no enlargement of the inguinal lymph glands nor was there any difficulty of urination. A No. 26 F. sound passed readily to the bladder and rectal examination revealed no abnormality of the prostate. On admission, no involvement of the perineum was noticed but the following day the buttocks in the region of the ischiorectal fossæ were inflamed and œdematous. Smears and cultures made from material obtained through the cauterized skin surface showed a hæmolytic streptococcus of the long chain variety. Under local anæsthesia the penile and

scrotal skin was removed, and long incisions were carried posteriorly into the buttocks, gangrenous tissue and many pus pockets being encountered throughout. Hot permanganate dressings and daily hot baths constituted the further treatment, the slough being cut away daily. Two days after the primary incision the perineum came away, this being a most unusual condition and one noted in the literature but once. After a week granulation tissue was evident and with surprising rapidity the scrotal skin began to regenerate. Patient left hospital healing rapidly; has not returned for observation.

CONCLUSIONS

1. Acute streptococcus penile and scrotal gangrene is a clinical entity readily distinguishable by careful examination from urinary extravasation, diabetic gangrene, and the passive œdemata of certain other organic diseases.

2. It is apparently an acute streptococcus infection of the skin and subcutaneous tissue comparable to erysipelas.

3. Like erysipelas, it spares the underlying structures.

4. Unlike erysipelas, it is characteristically a gangrenous process, though gangrene is not unknown in erysipelas elsewhere in the body.

5. Mortality is between 20 and 25 per cent.

6. Spread of the disease may be controlled by excising gangrenous skin and draining gangrenous, and suppurating subcutaneous tissue.

7. Regeneration of scrotal skin is rapid.

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CALCULI WITHIN THE BRAIN

Report of a Case of Intracranial Calcification with Successful Operation and Recovery[1]

By ELI A. MILLER, M.D., Denver

INTRACRANIAL calcification is encountered but rarely in the practice of medicine as indicated by an examination of the literature. An exhaustive study of the subject was recently made by Heuer and Dandy who found up to 1916 there had been but 7 cases reported, all by foreign observers.

Lichtheim had demonstrated a calcified gumma. Fittig observed by roentgenological examination three calcified areas in cyst walls in the occipital lobe of a brain; Grunmach noted a shadow due to a calcified tumor of the pineal gland; Schuller reported an osteoma in the frontal region; Algyogi, a basal tumor, with areas of calcification; Kleinberger, a tumor in the occipitoparietal region; Stieda, a calcified cysticercus; and Strater a calcified brain abscess recognized after its disclosure at operation.

Heuer and Dandy reported 6 cases of their own found in a study of one hundred clinically demonstrated brain tumors as follows: One case of calcification of the brain substance, one of calcification in the sella, one of aneurism of the internal carotid artery, and two cases of calcification above and very close to the sella.

Subsequently George reports the case of a man 23 years old in whom stereoscopic examination of the head made in the lateral position showed an area of about 3 centimeters in diameter posterior to the sella with apparently calcified walls. The patient had been injured in the head while playing football and rendered unconscious. He subsequently developed epileptic attacks which persisted for 18 months, when an operation was performed which revealed a small tumor situated just below the pia mater and adherent to the midfrontal lobe, diagnosed as an encapsulated glioma.

J. T. Murphy reports the case of a woman, age 47, in whom the X-ray showed a series of fine calcified lines each forming a part of a circle which was seen to be above and behind the sella and about midway between the left side of the skull and the median line, the whole making a barrel-shaped shadow. The

[1] Read before Denver County Medical Society, November 15, 1921.

exact diagnosis was not clear to the writer, but he seemed to think that it was either a cyst of the brain or an aneurism of the anterior cerebral artery. His patient suffered with paralysis of the right arm and leg, there was a disorder of the faculty of language, drooling from the right side of the mouth, convulsions and headache. The patient was placed on small doses of iodides. She improved greatly. Most of the symptoms subsided, only a small facial paralysis remaining.

Bassoe and Hassin give a detailed clinical and histological report of a man age 32 in whom there was calcification of cerebral vessels with a clinical picture simulating brain tumor. Histologically there was an indurated area measuring about 2 by 3 centimeters, occupying the basal ganglions and centrum semiovale. It was ill-defined, merging into the surrounding normal tissue, and it was in this area that microscopic, pale, calcified, bodies were present. They conclude that the white substance of the brain may be the site of a peculiar degenerative process followed by calcification. The lime deposits originate in the tissue spaces which primarily show a hyaline or colloidal degeneration as the result of some metabolic disorder. The degeneration results in defective drainage of the tissue fluids which become stagnant and ultimately calcified.

True bony tumors (osteoma and osteosarcoma) or tumors which have undergone calcification or ossification, cast shadows on the X-ray plate that can be readily recognized; nevertheless a search of the literature reveals less than twenty recorded instances.

The case described here differs markedly from those found in the literature in that the roentgenological examination reveals shadows which have the appearance of stones or calculi within the brain substance and these were successfully removed at operation.

Mr. F. A. D., age 60, a garageman by occupation presented himself October 10, 1921, for the relief of epileptic attacks, which had become more severe and more frequent recently; he had had from three to five attacks a night during the previous week.

The patient had the usual childhood diseases including measles, mumps, and scarlet fever at 12 years of age. At the age of 14 he had had an attack of appendicitis, but was not operated upon. During

Fig. 1. Roentgenogram. Three small calcified areas in left parietal region embedded in brain, two about ¾ inch deep, and one about 1 inch deep.

this attack he had been confined to bed for over 6 weeks, and was very seriously ill with a high fever and a marked swelling in his right side. He had no trauma and denies venereal disease. He uses neither alcohol nor tobacco.

About 26 years ago, the patient had his first epileptic attack which came in the night without any warning. There had been nothing unusual in his activities on the day before. The patient was awakened from a sound sleep by a terrible grinding sensation in his head over the left parietal region, and there was a slight twitching in the fingers of his right hand, also there was vertigo, faintness, and sudden visual sensation followed by cloudiness of consciousness.

Subsequent attacks occurred at intervals of about a year or year and a half in the following 10 or 12 years. Then he had the attacks more frequently. In 1913 he was having an average of two attacks a month. He was operated upon by Roswell Park at Buffalo General Hospital in June, 1913. A trephine was performed; a tumor in the left parietal region was suspected; nothing, however, was found and the attacks returned a few weeks after operation. In the last 2 years he was subject to two or three spells within a few days and then he would be free from attacks for a week or more.

There is no family history of epilepsy, insanity, diabetes, kidney, or heart disease. His father died of cancer of the stomach at the age of 65, his mother died of pneumonia at the age of 56, his wife died following an operation for uterine fibroids. One daughter, age 24, is living and well, one son, age 26, has pulmonary tuberculosis, one daughter died following childbirth, at the age of 22.

At the time of presenting himself for relief the patient was subject to three to five epileptic attacks

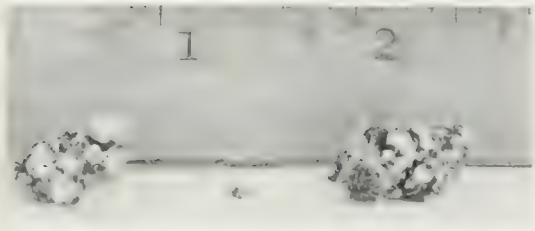

Fig. 2. Photograph of calculi. Natural size.

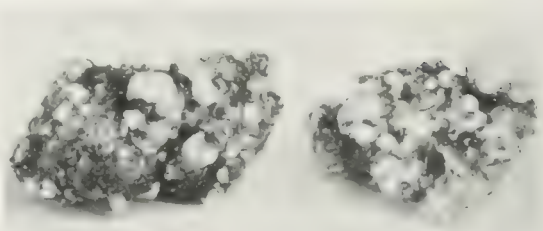

Fig. 3. Enlarged photograph of first stone.
Fig. 4. Enlarged photograph of second stone.

a night. These attacks come on for the most part a few hours after going to bed. He is awakened suddenly by an aura in which he feels numbness and tingling of the middle and ring finger of the right hand. Then these fingers begin to twitch, this is transmitted to the thumb, the hand flexes forcibly on the forearm, and forearm on the arm. The right side of the face twitches, later becoming more generalized and the entire body becomes affected with convulsive movements clonic in character. He does not cry out in the beginning of the attack, and remains in a state of consciousness throughout the greater part of the attack. He has a most distressing awful grinding sensation in his head in the left parietal region and it seems to him ages of torture, before he is finally blessed with loss of consciousness. He has enough warning to be able to self-administer chloroform which sometimes aborts the attack. Each attack lasts from 20 minutes to half an hour and recurs at short intervals several times during the night. During the attack his consciousness is clouded and mental faculties are dulled, but after the attack is over he is normal. He has no false sight or hearing during or following the attack.

Further he complains of nocturia 4 to 6 times per night since the onset of his frequent epileptic attacks, of pain in the back across the sacro-iliac region which was entirely relieved by strapping, of weakness in his right hand. When walking he feels like falling due to a sinking sensation and weakness. There is no burning on passing urine, no swelling of ankles, and no puffiness of eyelids or face. He is either badly constipated or has severe diarrhœa.

Physical examination. October 10, 1921. The patient is a well-developed, well-nourished individual 5 feet 8¾ inches in height weighing 176 pounds. His head is round and symmetrical, his ears are normal, he has a scar over the left parietal region marking the site of the previous operation, but there are no scars due to falls. This area is soft and no masses are palpable. His pupils are equal, they react normally to light and accommodation; the eyelids close normally. Many teeth are missing and the remainder are in bad condition. The tongue shows no scars or signs of being bitten; it is moist, coated, and protrudes slightly to the right with a fine tremor. There is some smoothing out of the right side of the face but mouth is not drawn to either side on showing teeth or laughing.

Chest. The lungs appear to be normal. The heart borders are normal to percussion; the second sound in the mitral area is somewhat muffled, the cardiac rate is seventy-six, and the rhythm is good. Examination of the abdomen reveals nothing abnormal. There is a marked paresis of the right hand, the grip of the right is very much weaker than the left, although patient has always been right handed. There is some atrophy of the muscles of the right hand.

Ophthalmoscopic examination was made by Dr. Stillwill who reports that there are no tortuosities of the retinal veins and arteries, that the nerve head is of normal color, that the choroidal ring is not distinct, and the cornea and iris are clear.

The systolic blood pressure is 170, the diastolic 105. A Wassermann test on the blood gave a negative reaction. Urinalysis reveals a trace of albumin and an occasional hyaline and granular cast. Several subsequent examinations of the urine after the patient was put on increased fluids and the use of chloroform was abandoned, were negative for albumin and casts.

Mentally, patient is of more than average intelligence and does not manifest any impairment.

Roentgenological examination was made by Drs. Childs and Crosby. Stereoscopic plates show several calcified areas within left parietal lobe. These bodies seem to be just subcortical in white matter.

The patient was put on 1 grain luminal twice a day at 4 p. m. and at 9 p. m. which at first seemed to stop the attacks, but he complained of being "out of his head" during the time he was under the influence of the drug, and he refused to continue it.

Small doses of iodides, and bromides in the form of the elixir of sodium bromide, a dram four times a day, seemed to reduce the number of attacks greatly. Under a general hygienic régime, with increased fluid intake and improved elimination, his blood pressure was reduced to 155 systolic and 90 diastolic, albumin and casts disappeared from the urine. The general condition of the patient was much improved, although he was showing the effects of bromides. He was beginning to have many minor attacks some of which he could abort by a tight constriction about the wrist.

Operation. The patient was operated upon November 5, at St. Anthony's Hospital, Denver.

Under ether anæsthesia, a semilunar incision over the left parietal region was made beyond the old trephine area down to the periosteum of the skull. A large horseshoe-shaped flap of scalp was turned down, great care was taken in the separation of the scalp from the dura at the site of the previous operation. There were dense adhesions to the dura, but by careful dissection with a periosteal elevator a fine separation was accomplished. The dura was fibrous, dense, and somewhat tense. A curved incision in the dura over the left motor area was made and a flap turned down. There was some bleeding from the brain surface, but it was easily controlled. The surface of the brain appeared normal. On introducing a needle into the substance of the brain in the parietal region on a line with the external auditory meatus resistance was felt 1 inch from the surface. There was a twitching of the right hand. After careful separation of the brain tissue a solid mass was elevated. This calculus was crushed by the grasp of the forceps. Palpation with a finger in the opening through which the first calculus was removed revealed two other calculi lying posteriorly in a smooth walled cavity. These were removed without breaking by grasping them with Allis forceps guided by the finger. The cavity in which they were lying was smooth to the touch. There was very little destruction of the brain tissue by the operation. It was possible to make an excellent closure of the dura and scalp without any bulging of the brain.

On postoperative examination after recovery from the anæsthesia the right hand was found to be paralyzed, there was no impairment of speech; no facial paralysis; no paralysis of the right arm and forearm. The hand was flaccid with the fingers flexed. This condition is improving. The patient was given urotropin (hexamethyleneamin) by mouth for 2 days previously and for a week after operation. He has had no epileptic attacks since operation.

Pathological report. The specimens removed at operation are solid calculi, grayish white in color, irregular in shape, with many projecting nodes like the mulberry. One of these measures ¾ inch by ½ inch by ½ inch, the second measures ⅝ inch by ½ inch by ⅜ inch, the third was approximately of the same size but was crushed in removal.

Chemical analysis was made by Drs. Hillkowitz and Gauss. They report that the calculi are composed almost entirely of calcium oxalate with organic material, probably decomposed blood.

Intracranial calcification may be classified under the following general heads:

The first is the calcification which occurs in cyst walls and in the walls of abscess cavities. These cysts have been observed both in infancy and adult life. Infants showing cyst formation usually present evidence of impaired mental development or a spastic paraplegia. The calcification occurring in adult skulls are usually associated with cysts which are secondary to a fracture of the skull or subdural hæmorrhages.

Under the second are grouped the deposits of so-called "brain sand." Among these are the deposit of lime in the pineal body. The deposit of brain sand in the falx cerebri, the so-called psammoma, are classified by some pathologists as true bone tumor or osteoma.

Under third heading is the calcium deposit in the walls of the blood vessels of the brain.

Under the fourth heading is the deposit of calcium in brain tumors, and with these are included gummata and tuberculomata.

Under the fifth are grouped the true bony tumors osteomata and osteosarcomata.

Finally there is the class of calcified bodies which occur in the white substance of the brain upon the site of a peculiar degenerative process of which Bassoe and Hassin speak. The lime deposits originate in the tissue spaces which primarily show a colloidal degeneration as the result of some severe intoxication with consequent metabolic disorder. The degeneration results in defective drainage of the tissue fluids which become stagnant and ultimately calcified. It seems to me that this is the probable explanation of the calculi within the brain substance in my case.

In conclusion the writer wishes to thank Dr. L. I. Miller, Drs. McCartney and Sams for their kind advice and assistance; Drs. Childs and Crosby for their roentgenographic studies; Dr. Stillwill for his ophthalmoscopic examination; and Drs. Hillkowitz and Gauss for their pathological and chemical studies.

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UTERINE HÆMORRHAGE OF ENDOCRINOPATHIC ORIGIN[1]

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THE process of menstruation is dependent on the interaction of the chain of ductless glands and the uterus. Whether the uterus can be accepted as a ductless gland is still unsettled. The myometrial gland has not been definitely proved to have a constant existence or an internal secretory function. We know that the presence of the ovaries alone does not insure the menstrual function but that the absence of the ovaries precludes the advent of this process. The presence of uterus and ovaries may not result in the appearance of the periodic monthly uterine hæmorrhage, for in some instances, individuals with apparently intact pelvic organs may have no menstrual flow or may have a more or less periodic flow from other body surfaces, i.e., so called vicarious menstruation.

We can see from these facts that the function of menstruation depends on other factors than the mere presence of the uterus and ovaries. To menstruate normally, a woman must have uterus, ovaries, and the *proper stimulus* from some *other source* which has been hypothetically accepted to be the ductless glands. There seems to be no definite gland that elaborates the stimulus, though, as we have already mentioned, the presence of functionating ovaries is absolutely essential.

Because of the pathological variations in the menstrual function in many diseases associated with endocrine disturbances, such as myxœdema, exophthalmic goiter, acromegaly, dystrophia adiposo genitalis, tumors of the hypophysis and adrenals, it has been assumed that all these glands play a rôle in the production of menstruation, and, that variations in the physiology of these glands result in disturbances of the menstrual function. In other words the entire chain of the so-called ductless glands is involved in the process of initiating normal menstruation and variations from the normal type must be due to disturbances in one or the other of these glands or in a group of them, leading to a flaw in the normal concerted action of the chain.

Uterine hæmorrhage aside from the normal periodic bleeding has been in a gross way classified in two large groups: (a) due to systemic conditions, (b) due to local conditions. Under (a) are grouped cardiac diseases, diseases of the liver and kidney, anæmia, hæmorrhagic diatheses, as purpura, and the acute infectious diseases, as scarlet fever. Just what causes the bleeding in these cases other than a local congestion is difficult to state as the description of this symptom and observations of its course, and character of its variations, in the course of the above-described diseases are very meager.

Under group (b) we have bleeding due to (a) local inflammatory lesion of the pelvic organs, (b) malpositions and displacements, (c) foreign bodies, (d) tumors of the pelvic organs, (e) a condition with no gross lesion but some histological (?) or physiological changes in the uterine wall, vessels, or ovaries.

The bleeding due to local inflammatory diseases, malpositions and displacements or foreign bodies is in most instances scant in amount and in all probability is dependent on the mechanical disturbance to the pelvic circulation or local injury. Some of the instances of profuse hæmorrhage may in these cases also be due to some interference with the proper function of the pelvic organs, as ovary or uterus. The two subgroups, "tumors and non-demonstrable gross lesions," form a topic of great interest. It has been assumed that in cases of tumors of the pelvic organs, the mechanical affect of the tumor accounts for the bleeding, though no thought is given to the many instances where tumors occupying similar positions as those associated with hæmorrhage as a symptom, do not cause bleeding.

Bleeding due to tumors can be divided into two types: Those in which the hæmorrhage is a purely local manifestation of an erosive or ulcerative condition of the tumor and those

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in which, without invasion of the uterine cavity or ulceration of its walls, we have bleeding, often of a most intractable nature. The first type is illustrated by the carcinomata of the cervix or uterus. Here we have a very friable neoplasm which at the slightest trauma bleeds because of the damage directly done to vessels in the tumor proper. This, too, is true of other types of submucous growths that have by pressure or degeneration and necrosis opened vessels of greater or lesser size and that bleed because of the direct injury to the vascular channel.

The second type cannot be explained on these grounds as they have not opened vessels, nor caused erosion of the mucosa, nor are they friable or exposed to trauma. Under this heading is the great group of fibromyomata and ovarian and tubal tumors. Here the symptom of hæmorrhage is a varying one. True, in most instances of fibromyomata there is a history of atypical uterine hæmorrhage, but truly not dependent on any local effect in a majority of the cases.

In a study of 250 fibroids, 192 gave a history of menorrhagia or metrorrhagia irrespective of the size or situation of the tumor. Of the 58 that had no menstrual irregularities, there were many that grossly were identical in size and situation with some that were associated with pathological uterine hæmorrhage. This makes it unlikely that purely mechanical factors played a rôle in these instances.

A histological study of the mucosa in these (Fig. 1) 192 cases show in 168 a marked hypertrophy irrespective of the phase of the normal menstrual cycle. This was the only constant lesion found. It has already been described in detail in a previous paper (1). It might be mentioned here that this change in the mucosa is also a characteristic in cases of uterine hæmorrhage without gross lesions as will be mentioned later and also in cases of ovarian and tubal tumors (Fig. 2) accompanied by metro or menorrhagia. We see that it is not the size, shape, mechanical embarrassment to the pelvic circulation nor the ulceration or necrosis of the tumor that gives rise to this atypical bleeding and we must, therefore, seek another explanation to

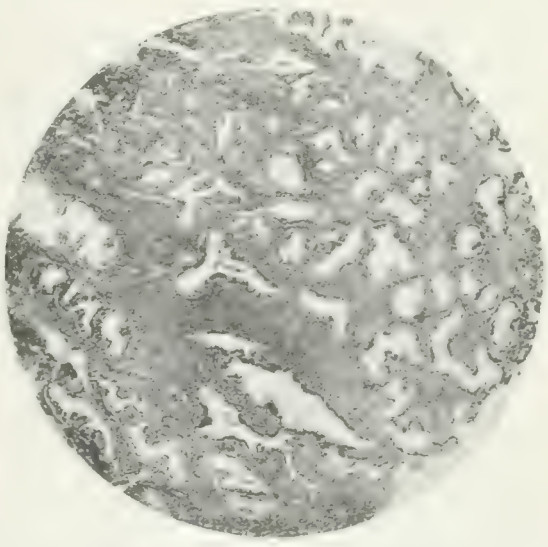

Fig. 1. Mucosa form a uterus containing multiple fibroids, bleeding for 3 weeks.

account for the phenomenon. As we previously suggested in the paper quoted above, we must look for the etiological factor in some disturbance of endocrine balance. We can also utilize for purposes of argument the similarity between the histological picture of the hypertrophied mucous membrane found associated with this condition and that of the normal premenstrual phase, as well as that seen in the cases of so-called "essential uterine hæmorrhage." The reaction of the mucosa in the three types of cases is so similar that it seems reasonable to suppose that the same stimulus, namely endocrine activity either the product of one gland (the ovary), for that at least is essential for this change, or a group reaction is responsible for the hypertrophy.

In view of the fact that removal or raying of the ovaries will cause a disappearance of the mucosal hypertrophy and also a cessation of the hæmorrhage, it is proper to conclude that its activity at least is necessary for the two processes and so give weight to the supposition that the hæmorrhage associated with fibroids, except in those instances mentioned above as due to local effects, is dependent on an endocrine disturbance.

The same method of reasoning and the same findings in the mucosa would lead us to

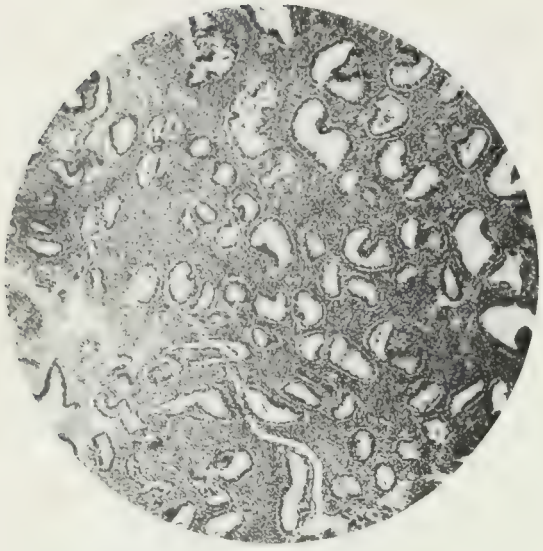

Fig. 2. Mucosa from a uterus in a case of ovarian cyst, bleeding for 5 weeks.

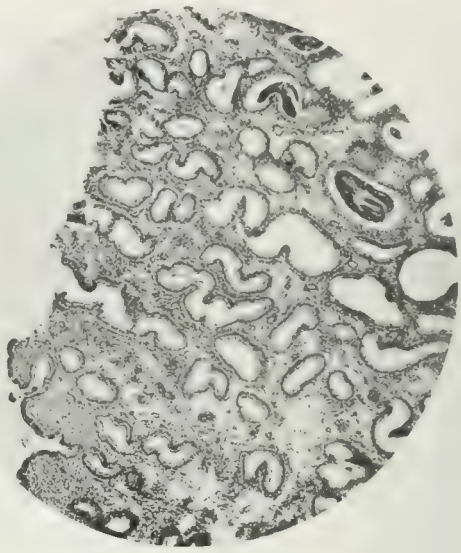

Fig. 3. Mucosa from a case of essential uterine hæmorrhage, bleeding 8 weeks.

similar conclusions in reference to the hæmorrhage associated with tumors of the ovary. Abnormal bleeding is not a common symptom associated with ovarian tumors and it is only in those cases where the function of the ovary is abnormal, resulting in a disturbance in the entire endocrine balance, that this expresses itself in uterine bleeding of an atypical character. Here, too, the findings in the uterine mucosa would tend to substantiate this theory.

An interesting group of tumors are the uterine polyps. By this term is meant small pedunculated masses composed of endometrial tissue and not pedunculated fibroids submucous in situation. These local growths seem to me not to be true neoplasms but more in the group of local hypertrophies. One finds them often associated with fibroids, at times solitary, at others multiple. Again they are present with no other lesion except perhaps an hypertrophy (more or less marked) of the mucosa. They are often associated with atypical uterine bleeding, either an exaggeration of the normal period (menorrhagia), or sometimes metrorrhagia is present, especially if the polyps are ulcerated. It seems rather odd that these growths of the same elements as the mucosa should give rise to the rather profuse hæmorrhage that characterizes them at times. The examination of these small tumors grossly and histologically does not offer a rational explanation. They are not always eroded or necrotic. Often they are very hæmorrhagic, much more so than the remainder of the mucosa, especially when they protrude through the internal os. They are not malignant, they do not grow very large, they do not infiltrate, or metastasize, though a malignant tumor may develop at their site. There is a tendency for more of them to form when they have been removed by some local procedure. The impression created is that they are the result of some stimulation that produces local hypertrophy instead of the general hypertrophy as seen in the essential hæmorrhage type of case, or in cases associated with fibroids. They are, however, often found in addition to the general hypertrophy present in bleeding cases, and it seems that the hæmorrhage so commonly associated with these polyps is the expression of a general process of which the polyp is just a local manifestation.

In the normal menstrual cycle the uterine mucosa undergoes a periodic variation with an overlapping of the different phases. This was pointed out first by Hitchman and Adler

and has since been corroborated by a large number of investigations. The varying phases are well known and need no further gross descriptions.

It is still accepted by many medical men that the hæmorrhage one encounters in women who have no grossly demonstrable lesion except a uniformly enlarged uterus is due to a fibrosis, an endometritis or a vessel disease.

It has been repeatedly demonstrated that endometritis is a very rare disease, except the acute type that follows instrumentation or delivery, and that the condition, chronic endometritis, is rarely present in cases that have atypical uterine hæmorrhage, and can hardly be held to be the etiological factor in a condition that is much more conspicuous by the absence than the presence of its supposed cause.

It was pointed out also (2) that in cases of so-called essential uterine hæmorrhage, the one characteristic finding in the uterus was an hypertrophy of the mucosa simulating an atypical premenstrual phase with œdema of the stroma, enlarged, sometimes tortuous, almost always, cystic glands, and this irrespective of the stage of the menstrual cycle (Fig. 3). It was suggested that the stimulus that caused the normal changes in the mucosa also caused by some perverted activity, the abnormal condition found in the bleeding cases. Furthermore, because we know that these changes do not take place after the removal of the ovaries or the abolition of their functions, we advanced the theory that the ovaries are essential for the change in these pathological cases. As we know that the ovaries are essential for the production of the uterine bleeding, normal or pathological, we conclude that the same factor is the causative agent for the hæmorrhage and for the hypertrophy. We see, therefore, that all cases of uterine hæmorrhage, not associated with tumors that are ulcerated, necrotic or friable or with conditions that may be dependent on purely local pressure or congestive phenomena such as tubal pregnancies, inflammatory diseases or displacements, and accompanied by a definite pathological, almost pathognomonic, condition of the mucosa are dependent on the presence of the ovaries. These findings lead us to the supposition that bleeding and hypertrophy of the mucosa are due to a stimulation dependent in part, at least, on the activity of the ovary. Whether the mucosa itself plays a rôle by the production of a substance or substances that actually precipitates the hæmorrhage and maintains it cannot be stated, but it seems possible that the mucosa in its hypertrophic condition is producing some substance which may be an active factor.

Analyzing our cases of hæmorrhage, whether due to fibroids, ovarian or tubal tumors, or in those cases where no gross lesion exists, we must admit a striking fact that they can all be cured by the removal of the ovaries or by raying in proper dosage and that they all are characterized by the hypertrophied mucosa previously described.

In view of this, I feel that it is fair to suggest that all these cases when associated with bleeding have as the etiological factor for their hæmorrhage, not the local condition, but some disturbance of ovarian function which may or may not be the only factor involved. In all probability it is only one of the glands at fault, the result of this variation being that the entire chain, i.e., thyroid, hypophysis, adrenal and ovary, does not functionate normally. This abnormal action of the endocrines expresses itself in the hypertrophy of the mucosa which tissue may be the source of some chemical stimulus that initiates and maintains the bleeding.

Unfortunately at the present time endocrine therapy is still in the experimental stage and most of the administration of the various products is purely based on empiricism. It is to be hoped that eventually we shall have developed a rational therapeusis, and it will be in just these cases of pathological hæmorrhage that much good will be accomplished.

I wish to thank Dr. F. S. Mandlebaum, director of the Pathological Department, for the excellent photomicrographs and for the privilege of studying the material.

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DEPARTMENT OF TECHNIQUE

CORRECTIVE RHINOPLASTY

Some Anatomicosurgical Considerations[1]

By LEE COHEN, M.D., F.A.C.S., Baltimore

THE widespread interest manifested in corrective rhinoplasty during the past decade has finally given to this class of work the real place in surgery to which it is entitled. Some men, however, still maintain an air of opposition on the ground that such purely cosmetic work is unworthy of serious surgical consideration. I take issue with my friend, Dr. Beck (1), in his recent "Review of Twenty-five Years Observation in Plastic Surgery, etc.," who would differentiate between patients really requiring operations because of mishap and those with congenital deformities who merely desire operations for cosmetic reasons. As a matter of fact, all plastic operations about the face are, as I see them, for the sole purpose of improving the individual's appearance. No surgeon would refuse to restore form, where possible, to a nose sunken from septal abscess. Why then refuse correction of an equally deformed nose of this type, of congenital origin? Likewise, when a patient is made self-conscious and his entire mental outlook on life is perverted, through the possession of a grossly oversized or humped nose, why should he not be accorded the same privilege of relief?

In the above-mentioned review, Beck further emphasizes the element of neurosis and the difficulty in satisfying many of these patients. In my experience, patients with deformed noses are no more neurotic than those with other deformities about the face, such as hare-lip, squint, scars, etc., and, but for the existing defect, quite likely the nervous system of none of them would be disturbed. The obvious remedy for this neurosis in any case, therefore, is a correction of the deformity. Moreover, the gratitude shown by no class of cases compares with that of patients after the successful performance of these plastic operations; their joy and happiness has to me been a real inspiration.

In this, as in all other surgical procedures widely employed, the most expert cannot always expect ideal results. How much more likely then are utter failures to occur in this tedious and quite difficult field in the hands of some who, after witnessing a few operations, attempt them without anatomical study, practice on the cadaver, or in many instances without even a moderately liberal training in general surgical technique. These same men, with no greater training, would hesitate to perform a major abdominal operation wherein failure might register a death to their credit. In no other field of surgery does close attention to the most minute detail, both in the operation and after dressings, count for more in obtaining the desired result. It seems, therefore, timely here to sound a note of warning to men who contemplate doing this work, and to emphasize the need of careful preparation and study, lest failure crown their operative effort and bring upon them, and upon the work as a whole, the opprobrium of the patient and the profession as well.

In previous monographs (2, 3, 4, 5, 6) almost all types of nasal deformities have been considered by the writer and many phases of the subject discussed, but there are some finer details in technique that might still be brought out.

I would here first present for your consideration the reduction of congenital overgrowth of the cartilaginous nose, existing in many instances without deformity of the bony portion. Although this operation may seem trivial compared to some of the more extensive work on the bony nose, the surgeon's judgment is often taxed to its utmost in determining the extent of the incision and how much tissue should be removed.

Figure 1 represents the skeleton of a nose with a markedly oversized cartilaginous portion; not only is it too wide but the tip stands prominently above the dorsum of the rest of the nose. This exaggerated tip is, in the vast majority of cases, due to an overgrowth of the greater alar cartilages, although in some instances the lateral cartilages also take part in a more general enlargement. In

[1] Read before Clinical Congress of American College of Surgeons, Philadelphia, October 26, 1921.

Fig. 1. Skeleton of nose with markedly oversized cartilaginous portion. Not only is it too wide, but the tip stands prominently above the dorsum of the rest of the nose.

Fig. 2. The double-edged pointed knife, curved on the flat, is tunneling its way between the cartilage and the overlying skin. The knife is introduced from within the nose 3 millimeters above the edge of the anterior nares, close to and on each side of the septum.

each case it is necessary to determine before operation whether one or both pairs of cartilages are overgrown, as the amount of tissue excised must vary with the extent of the enlargment.

Figure 2 indicates the double-edged pointed knife, curved on the flat, tunneling its way between the cartilage and the overlying skin, having been introduced from within the nose 3 millimeters above the edge of the anterior nares, close to and on each side of the septum. The knife penetrates the lining and cartilage and tunnels its way upward over the tip, beneath the skin, until it passes the uppermost limit of the overgrown area, where the point again enters the nasal chamber. This may be at the dividing line between the major alar and lateral cartilages, or where the lateral cartilages are attached to the bony edge of the pyriform opening. After sufficiently widening these tunnels by cutting laterally, a strip of tissue 5 to 7 millimeters wide, including the cartilage and its lining, is excised from the dorsum on both sides of the septum, as indicated in Figure 3. The punch forceps of Joseph or a pair of straight pointed scissors may be used for this purpose.

The width of the nose is thus reduced in direct proportion to the width of the strips removed. Care should be taken, therefore, that too wide a strip be not excised, lest the breathing space be unduly diminished after healing and subsequent contraction.

In order to narrow the nose to the desired extent, two other incisions must be made, also from within, extending laterally from the upper end of each of the vertical defects to the root of the nose, thus permitting the edges of the dorsal defects to fall into apposition. Sutures are not required in these situations. In fact, any attempt to use them results in a puckering of the overlying skin. Lateral compression of the lower end of the copper splint, after it is placed over the nose, is relied upon to hold the wound edges in contact.

To lower the tip and place it on a proper plane with the bony dorsum, incisions are made in the mobile septum, as indicated in Figure 4. With a double-edged, straight-pointed knife, the subseptum is transfixed just above the skin edge of the columella, and a cut extending from the tip to the anterior nasal spine is made through the entire septum. The septum is again transfixed at the junction of its cartilage with the subseptum, and an incision about one-third shorter and parallel with the former one is made. Now, with a pair of straight pointed scissors, a section of the entire septal tissue between these two incisions is excised. The length of the section thus removed should be in proportion to the extent of the desired replacement of the tip. Generally speaking, it varies from 0.5 to 1 centimeter and must not exceed this amount, or later contraction is likely to overcorrect. Besides, where too much tissue is removed the redundancy of skin covering the columella is not entirely overcome by shrinkage, and an unsightly puckering results after suturing. When the gap created by the removal of this section is closed, by bringing the anterior and posterior edges together with one through-and-through suture of heavy black silk (indicated

Fig. 3. A strip of tissue 5 to 7 millimeters wide, including the cartilage and its lining, is excised from the dorsum on both sides of the septum.

by dots), the tip is drawn downward. A sufficient number of superficial sutures of finer silk on each side of the septum serve to close the wounds completely.

The method of dressing may be of interest. The nasal fossæ, for an inch back of the vestibules, are packed with half-inch iodoform tape, leaving a portion of both vestibules just above the nares unpacked. The packing of this lower portion is now done in the following manner:

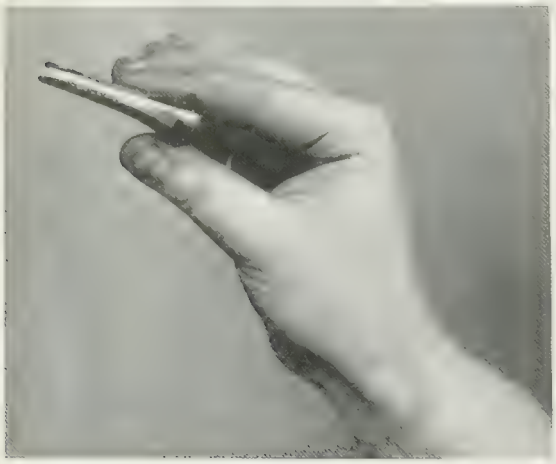

Fig. 5. Modification of Killian's speculum used to introduce the graft in correcting concave dorsal deformities.

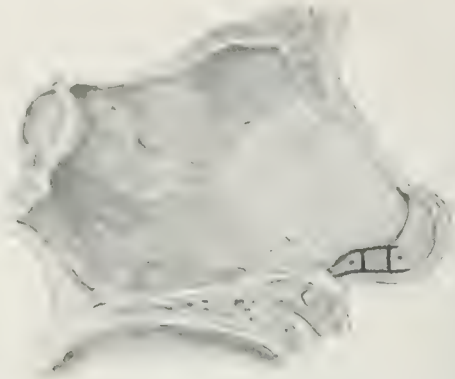

Fig. 4. Incisions are made in the mobile septum to lower the tip and to place it on a proper plane with the bony dorsum.

a gauze strip, laid flatly against the left side of septum, is brought downward out of the nose, around the columella, and carried upward into the right vestibule along the septum, when it is folded upon itself, again brought downward, around the columella, and into the left nares; and so on until both sides are loosely filled with gauze tape, which furnishes a perfect dressing over all septal wounds and the columella itself. A narrow strip of adhesive over this gauze covering the columella, and drawn snugly upward on both sides in the shape of a swing to be attached to the splint above, serves to hold the wound edges closely in contact, and lessens tension on sutures.

In applying the copper splint in these cases the adhesive strip holding it should be placed on a slightly lower level than usual, so that pressure thereby exerted on the tip of the nose will still further reduce tension on the main through-and-through suture.

The patient is required to remain in bed 4 days and to spend as much time as possible on

Fig. 6. Position of graft to take the place of the quadrilateral cartilage destroyed by septal abscess.

Fig. 7. Case 1 before and after operation.

Fig. 8. Case 2 before and after operation.

the back, so that the nasal secretions flow backward into the throat and lessen the likelihood of wound infection. The first change of packing is made on the fourth day, sutures being removed on the fifth. The splint should be continuously worn for 2 weeks, changing it every third or fourth day for purpose of skin toilet. In a number of cases thus cared for, primary healing and satisfactory results have been obtained, without exception.

Illustrating results, photographs of several patients before and after operation are here shown.

Case 1. Male, age, 20. Had a large bulbous tip projecting high above the plane of the rest of the nose. In the after-picture which we were obliged to take a couple of weeks after operation, because patient was forced to return to his home in Iowa, there still remains considerable general swelling, but the dorsal plane of the nose, you will observe, is perfect. This gross appearance will, as time goes on, disappear entirely with the swelling.

Case 2. Female, age 25. Swelling having disappeared before taking the after-picture, the nose presents a more natural form.

Case 3. Female, age 28. The nose was shortened and irregularities of the dorsum removed by operation in 1915. Patient returned 2 months ago and asked that the distance between the tip and root of the nose be reduced. This was done in the manner above described. The after-picture in this case was also necessarily taken before the swelling had entirely disappeared.

Perhaps of far more general interest, because the results appear more striking, but by no means so difficult of execution, are the operations for correcting concave dorsal deformities (so-called saddle nose), either congenital or acquired, by the use of bone or cartilage grafts. Grafts of septal and of costal cartilage have been used by different operators. Bone from the lower turbinate, the tibia, and that of the rib has been variously employed. All of these have been tried by the essayist, except the septal cartilage, which in my opinion has no place in this work, as absorption is certain to follow; besides it is seldom thick enough for the purpose.

Gillies' idea of using costal cartilage alone in all cases has not proven wise, in the experience of the essayist. Such grafts never form union with bone and are, therefore, never firmly fixed on the nose; they are always absorbed to a greater or less degree.

Likewise, bone grafts from the anterior edge of the tibia have proven a failure in several of our cases. The biological difference between the nasal bones, which in their construction, nerve and blood supply, closely resemble the rib, and the tibia with its large narrow canal and haversian system, would seem sufficient reason why the tibia graft does not unite with bones of the nose and become a fixed part of its bony framework. Then, too, after 4 or 5 years, so much of the tibia graft is lost through absorption that the results have been a disappointment to both patient and operator.

The irregularity of the lower turbinate, its thinness, and the fact that it is removed from a bacterially laden cavity, seem sufficient reasons for discarding it entirely in these operations.

The ideal substance in this work, as shown by results of the essayist, and also of Carter, has proven to be a graft composed partly of bone and partly of costal cartilage, taken from the seventh or eighth rib. The bony portion of this graft in all of my cases is firmly united to the nasal bones within 6 weeks. The costal cartilage, removed with and left attached to the rib bone, lies over the cartilaginous nose, and permits a certain amount of mobility in that portion not to be

Fig. 9. Case 3 before and after operation.

Fig. 10. Case 4 before and after operation.

obtained by bone alone. Besides a graft thus constituted can be made so long that the lower end presses slightly on the tissues of the tip of the nose, without any danger of subsequent sloughing of the skin from the pressure of the cartilaginous end of the graft. In this manner, therefore, by means of a dorsal graft, the nose can be made a trifle longer when necessary.

Danger of perforating the pleura, with a resultant empyema, has been offered as an objection to the use of the rib. Also the difficulty of properly shaping the bone, as compared with the costal cartilage, has been urged as another reason for the use of the latter alone. While perforation of the pleura is a very undesirable occurrence, and happened twice in my early work, without infection however, it cannot be held as a reason for not making use of the rib graft. With improvement in technique as the operation is now performed, perforation of the pleura need never occur. Moreover, if one's asepsis is beyond criticism, infection does not follow such perforation.

When but a shallow depression of the dorsum exists, it is unnecessary to take a section of the entire rib. A strip of the outer table, through the diploic structure down to the inner table, removed with sharp chisels, furnishes all the thickness required. In marked cases of saddle nose, where the entire rib thickness is needed to fill the defect, the periosteum of the outer table is twice incised along the axis of the rib. The distance between these two incisions, generally from three-sixteenths to one-quarter inch, indicates the width of the graft to be used. These incisions are extended as far into the costal cartilage as desired, and, of course, their entire length must vary according to the estimated length of the graft required. In this way the periosteum of the outer table is left attached to the graft. With a periosteal elevator, the remaining portion of the periosteum of the outer surface in the region of the graft is separated well over the upper and lower edges of the rib. It is now but a moment's work with the elevator to separate the periosteum from the entire inner surface, so that the rib shears passing between bone and periosteum never come in contact with the pleura.

It is my practice never to permit the graft to be touched by the fingers, either gloved or otherwise, nor is it permitted to come in contact with the edges of the wound while being introduced into the nose. By this, I am certain, infections are avoided. No difficulty has been experienced in trimming the graft any shape desired, with bone shears and heavy scalpel, when it is placed on a table covered with sterile towels and firmly held with bone forceps or in sterile gauze. To introduce the graft finally it is placed in a long speculum, a modification of Killian's for rhinoscopia media (Fig. 5). The speculum containing graft is introduced through the incision in the left vestibule, and passed upward all the way to the frontal notch. Pressure on the graft is now released with set-screw of the speculum, and graft pushed home with a pair of forceps as the speculum is withdrawn.

After placing graft in the exact position desired, the wound through which it is introduced is sutured with black silk. For all suturing within the nose the small, curved Riverdin needle has been indispensable. It must be borne in mind, as stated in previous papers, that undermining of the skin of the nose and preparation of the bed for graft is done through this incision in the wing, preferably through the left vestibule.

Another observation of importance is that, since contraction follows in the wake of every

incision made through the wing cartilages, it has been found best for the ultimate cosmetic effect to make similar incisions in both wing cartilages, though incisions on one side would suffice for the actual operation, so that contraction when it occurs will be equal on both sides, and not disturb the symmetry of the nose.

Much has been said about the relative value of the large and small incision through which the graft is introduced, and also of the dangers of infection where large incisions are made. My preference always is an incision of sufficient length to permit absolute freedom of action, always feeling assured that, with perfect technique, infection of graft is unlikely to result.

The graft is held in the mid-line of the nose by means of the copper splint which, when properly strapped with adhesive, also holds the graft in such intimate contact with the nasal bones that bony union has not yet failed to occur in any of my cases.

In saddle noses, following septal abscesses where the loss of the entire quadrilateral cartilage has taken place, it is necessary that some sort of support be furnished in its stead, to prevent a tipping downward of the lower end of the graft. This support is supplied by the introduction of a thin section of costal cartilage, of desired shape, which rests on the anterior nasal spine below and against the dorsal graft at the tip above (Fig. 6). It has been my custom to prepare a bed for this graft, under local anæsthesia, before ether is given to remove the rib and prepare bed for the dorsal graft. In this manner one avoids the obstacle offered by hæmorrhage, which at times is so profuse under ether as to obscure the field of operation and to render likely a buttonholing of the septal flaps. Should buttonholing of the flaps occur, infection of graft is almost certain to follow.

Fig. 11. Case 5 before and after operation.

Case 4. Female, age 30. Congenital saddle nose. The bridge in the region of the notch was so flat that it was impossible for her to wear eyeglasses. A section of the entire rib was used in this case. Operation was performed 14 months ago. After-picture taken 3 weeks ago. Graft in excellent state of preservation.

Case 5. Female, age 19. Acquired saddle nose, following septal abscess 4 years before. The entire septal cartilage was destroyed, and the resulting contraction caused an enormous depression. A dorsal graft of the entire thickness of the rib, with cartilage at its lower end, as well as a septal graft of costal cartilage was necessary in this case.

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BONE SURGERY OF THE NOSE[1]

By WILLIAM WESLEY CARTER, A.M., M.D., F.A.C.S., New York

NASAL deformities of whatever description are due to or are accompanied by abnormalities or irregularities in the shape, size, or position of the bony and cartilaginous framework of the organ. The function may be disturbed or the skin of the nose may be involved in various ways, but these are accompaniments to the much more important basic fault which lies in the framework. Upon our ability to reconstruct this or to adjust its component parts so that it will support the soft tissues and preserve the contour of a normal nose, depends the success or failure of our efforts to effect a permanent correction. I say permanent advisedly, because we all know that sometimes a misshapen nose may be forcibly mobilized and molded into perfect shape by means of splints, but if the correction does not involve the proper adjustment of the framework, the original deformity recurs with incredible celerity after these supports are removed.

My work has been confined to the human subject and, therefore, I have been unable to observe to any extent the microscopical changes occurring in bone and cartilage after transplantation, but I have kept some of my patients under observation for many years, for I began this work nearly 15 years ago, and by making frequent physical and X-ray examinations, I have found out what final clinical results may be expected, and I know from a practical point of view what happens to bone and cartilage when it is transplanted into the nose.

The subject, "Plastic Surgery of the Nose," is too broad and general, and I find myself unable to discuss, within the allotted time, more than one phase of the subject; so I will confine my remarks chiefly to bone transplantation and those basic principles which, as I have stated, furnish the keynote to all plastic surgery of the nose.

From a practical, mechanical, and architectural point of view, the nose is an arch composed of an indefinite number of bone and cartilage segments so placed that it will retain its shape and position when supported only at its extremities. The upper edge of the septum, where it is wedged in between the lateral cartilages, constitutes the keystone of the arch. The displacement or destruction of this or any of the other segments causes more or less collapse of the structure, resulting in a flattening of the curve and the re-establishment of the arch on a lower level. The septum, as a vertical support, strengthens the arch but is not necessary for the preservation of its integrity.

In recent fractures and in old traumatic deformities where there has been no loss of bone or cartilage, I am still using the bridge splint, which I devised a number of years ago and with which you are all familiar. This instrument holds the segments of the arch in proper position until union has occurred.

The most frequent use for bone and cartilage transplants in rhinological surgery is found in those cases where a deficiency in the frame work has resulted in a depressed deformity which may involve the tip as well as the dorsum of the nose. The most frequent causes of this deformity are: (1) congenital defects; (2) traumatism; (3) the submucous operation, due either to faulty technique or infection following the operation; (4) abscess of the septum; (5) atrophic rhinitis; (6) syphilis, tuberculosis, lupus, etc.

We must remember that the function of the transplant is not primarily that of a mechanical filler to replace tissues that have been destroyed; this is a secondary, though often an important consideration from a cosmetic point of view. Our chief concern is to restore the function and symmetry of the nose to their normal state by constructing a framework of normal tissues that shall be capable of supporting the soft structures of the nose in their proper position, and to do this if possible without leaving an obvious scar. In order that this correction, primarily secured, may be permanent and able to withstand the powerful influence of cicatricial contraction and elasticity of the skin, which must always be reckoned with, the foundations for the new framework must be carefully selected and the transplants accurately placed upon them. The bone graft must be alive and capable of growth and must establish bony union with the adjacent bones in its new position. The best results are secured by using autogenous, periosteum-covered transplants and placing them in contact with live bone, the periosteum of which is elevated at the point of contact with the transplant. Bare bone is useful for its mechanical and osteoconductive properties and, even if it is later absorbed, it is replaced by bone or connective tissue and the results are more or less satisfactory. It does not,

[1] Read before Clinical Congress of American College of Surgeons, Philadelphia, October, 1921.

Fig. 1. Congenital specific deformity at left, before operation. At right, deformity corrected by bone transplant (strut operation). Photograph taken 1 year after operation.

however, possess the inherent vitality of the periosteum-covered transplant.

It is not my purpose to discuss here the various views held by different writers in regard to the growth of bone and the influence of the periosteum in the regeneration of bone. My clinical cases appear to show that bone is formed by the so-called periosseous osteogenetic layer of the periosteum, and that the cells of this layer are protected and their growth limited by the connective-tissue layer of this membrane; this envelope being comparable to the limiting fibrous capsule which separates all highly specialized tissue, such as the liver, kidneys, etc., from the surrounding structures.

The vigor of the transplant is greatly augmented by placing it in contact with live, periosteum-covered bone. In none of my cases has there been an overgrowth of bone, the normal growth of the tissues here, as elsewhere in the body, being regulated by the functional demands and by the hereditary limits of growth for this locality. On the other hand, if the transplanted tissue lies passive and performs no function, it is soon absorbed, even though it had been received kindly by its host and had originally established vascular connections. This is in accordance with the physiological law that functionless tissues meet with no tolerance in the human economy.

For transplantation into the nose, I still use a section of the eighth or ninth rib and costal cartilage, removed at the time from the patient's right side. I have previously described my operation, but I feel that I am justified in briefly reviewing this for the sake of favoring the interpretation of my illustrations and to call attention to some modifications and improvements I have made in the technique. The patient is etherized and turned on the left side with a sand bag support under the lower chest wall. After the initial painting of the operative field with iodine, only freshly sterilized, physiological salt solution is used. All antiseptics, such as bichloride, alcohol, etc., are carefully avoided, as they are protoplasmic poisons and would cause the death of the transplant. A section of the rib, 2 inches long, is removed, the periosteum on the outer surface being preserved. If it is a case in which it is considered necessary for the transplant to extend into the tip, I remove the section at the costochondral junction, and have the graft consist of two-thirds bone and one-third cartilage. This preserves the resiliency of the tip. In some instances I remove only the outer half of the rib, but where I expect to need more than one piece, I do not hesitate to remove the entire section. There is no loss to the chest wall, for the deficiency is filled in with bone, in some instances, 2 months after the operation. The section of rib is split and the cancellous tissue scraped off with a curette. I prefer thin transplants and sometimes introduce several in preference to one thick piece, as the viability of the transplant varies in inverse proportion to its bulk.

The nose is then prepared for the reception of the graft. A small incision, through which all of the work is done, is made in the roof of the left nasal vestibule. (I have long since abandoned my original external operation.) The periosteum over the nasal bones and the nasal process of the frontal is elevated, and an incision made into the latter for the reception of the upper end of the graft. The subcutaneous elevation of the tissues extends over the nose and in some instances for a considerable distance under the cheeks. The transplant is then carefully placed in

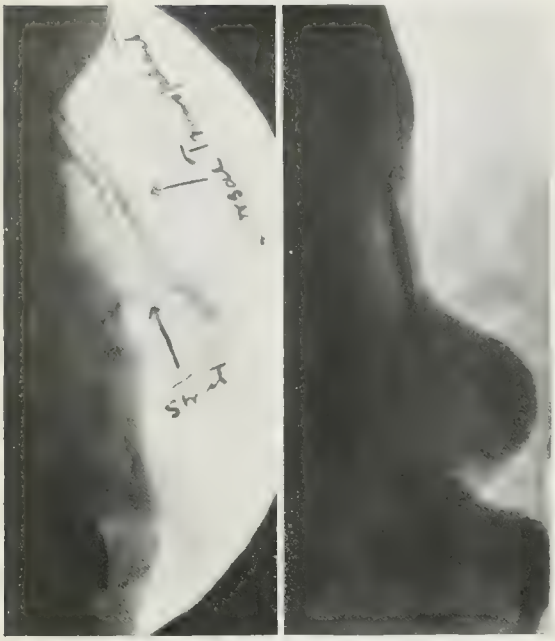

Fig. 2 (at left). Shows arrangement of transplants in strut operation as done in illustrated case. Note excessive growth in dorsal transplant where it comes in contact with the supporting strut.

Fig. 3. Bone transplant 6 years after operation.

position. No effort whatever is made to expel the blood clots, for this pabulum temporarily nourishes the transplant and the fibrin of the clot greatly favors osteogenesis. The entire nose is immobilized by means of a well-padded, tin-lined copper splint. In those cases where the traumatism has necessarily been great and the hæmorrhage considerable, I use my hot water jacket for the first 24 hours. This limits the swelling, aids in the establishment of the capillary circulation and diminishes the subsequent ecchymosis.

Under favorable conditions, in a healthy young subject, a bone transplant establishes firm, bony union with the frontal bone in about 2 months.

In cases where the tip is unsupported or the nasal bones are absent or collapsed and afford no fulcrum for the transplant, I introduce between the columnar cartilages a strut, composed of either bone or cartilage. The upper end of this strut rests under the lower end of the transplant and the lower end is anchored to the nasal spine of the superior maxilla. I have found this modification extremely satisfactory and use it in many of my cases. It insures the elevation of the lower end of the transplant and enables it to withstand the drag of cicatricial tissue and the elasticity of the skin.

Our object is to secure permanent results, and these are dependent upon the histological or pathological changes that occur in the transplanted bone. A discussion of this subject does not come within the scope of this paper. There is considerable difference of opinion, and I do not believe that the question will ever be settled definitely from the pathologist's point of view, for not only do results vary with varying technique, but it has even been found that among operators employing the same technique, the difference in personal equation produces diametrically opposite results. In my opinion the difference in results is caused: (1) by the inclusion with the transplant of more or less of the periosseous osteogenetic layer of the periosteum; (2) by infection at the time of operation; (3) by injury to the transplant in handling or from heat, antiseptics, etc.; (4) by differences in tissue metabolism of the host.

In syphilitic subjects, during the active stages of the disease and while they are Wassermann-positive, bone transplantation is not to be considered. I have secured good results in selected cases where the patient was apparently well of his disease and was in excellent physical condition. Here, in addition to the unusual severity of the deformity, and the large amount of cicatricial tissue, which is always present in these cases, we are contending with perverted metabolism, and a bone transplant is exceedingly sensitive to this. In specific cases one should always be guarded in his prognosis even under the most favorable conditions.

If the wound becomes infected a part or all of the transplant will die. If the infection is controlled without having to remove the graft, the dead portion will be absorbed. The periosteum is far more resistant to infection than bone. I have known the periosteum to establish vascular connections with the surrounding tissues and remain *in situ* after the removal of the dead graft.

Strict asepsis is essential in this work, for no progress was made in the transplantation of bone until after the introduction of aseptic surgery. No matter how slight the infection may be, a considerable absorption of the graft will occur. While the established immunity to the flora resident in the nasal cavities, the abundant blood supply of the part and the antiseptic qualities of the nasal secretion are factors in our favor, still we must not place too much reliance upon them, but must make every effort to secure a clean field.

I have had fewer infections since I adopted the intranasal route for the introduction of the transplant.

I have used cartilage to a considerable extent in the correction of minor deformities and irregularities and as a support where cartilage is normally present in the nose. I have secured excellent results in cases of collapsed alæ by grafting thin strips of cartilage into the wings. The use of gold-wire splints, as recently advised by me, after intranasal plastic operations, has added greatly to the efficiency of this operation. Cartilage is viable and is permanent and is more easily shaped to fit the deformity, but it never establishes osseous connection with the frontal bone, but remains always movable.

In conclusion I will say that in my opinion, based upon my own operative and clinical experience, the live, periosteum-covered autogenous bone transplant combined with cartilage when indicated is the ideal tissue for use in the correction of this difficult class of nasal deformities.

SECONDARY PERINEAL REPAIR

Description of a Simple Technique

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OF recent years there have appeared many descriptions of operative procedures for the secondary repair of perineal lacerations; it would, therefore, seem superfluous to add another technique to an already overstocked literature, especially as there is no great originality expressed, only, as the writer believes, an improvement upon the usual operations. The only extenuation that is made for this contribution is the simplicity of the performance and the correction along anatomical and pathological lines of a condition that is all too common.

In order to justify an operative procedure of this nature, a brief description will be made of, first, the anatomy of the pelvic diaphragm; second, the mechanics of the birth injury; third, the mechanics of repair by operation.

ANATOMY

The pelvic, or lower abdominal, diaphragm consists of a sheet of muscular tissue enclosed in a fibrous sheath, stretching across the bony outlet of the pelvic canal. The outlet of the pelvis consists of two triangular areas, the bases of which have a common line drawn from one tuberosity of the ischium to its fellow on the opposite side. The anterior segment has its apex at the pubic symphysis and its sides are the descending rami of the pubis. The posterior segment has its apex at the coccyx and its lateral boundaries are the ascending rami of the ischium. These two triangles are on two different planes. With the patient in the dorsal position the anterior one runs at right angles to the horizontal plane, the posterior one at an angle of 45 degrees. These facts are more of obstetrical value in the mechanism of delivery in outlet contractions, yet they have an anatomical bearing upon the causation of some of the perineal lacerations.

The muscles that bridge across this opening, making the pelvic diaphragm, are the levatores ani and the coccygeus. The levatores ani muscles are two fan-like structures having their origin from the posterior surface and lower border of the symphysis pubis, and extending backward on a line from this point to the spine of the ischium. This latter line of origin is the so-called "white line," which is thickened fascia—being the line of division of the obturator fascia into rectovesical and anal. The muscular fibers from the posterior and mid point converge in a fan-like manner to be inserted into the rectum. The anterior fibers arising from the posterior surface of the symphysis pubis form a sling that descends behind the descending rami, encircles the introitus and vagina, and are inserted into the rectum and coccyx. It is this latter bundle of muscles that has been named the puborectalis, or coccygeus, and which is subject to injury during delivery.

The fascial sheath of the levatores ani muscles consists of the rectovesical fascia upon its upper surface, and the levator or anal fascia on its under surface. As pointed out by Haynes (1), this sheath has the important function of reinforcing the muscles and binding the muscle fasciculi together in a compact manner, and aids

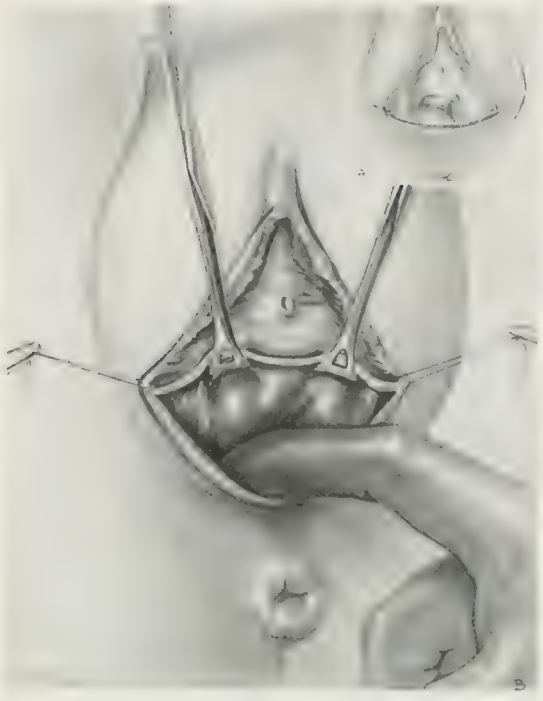

Fig. 1. a, Steps 1 and 2. b, Step 3. The index finger of operator's hand is shown making traction upon anterior rectal wall, thereby bringing the right puborectalis muscle into view.

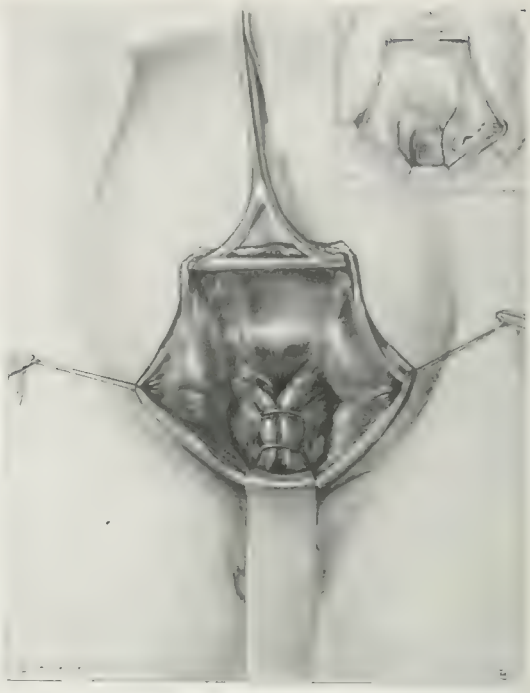

Fig. 2. a, Shows placing of suture through right puborectalis muscle and sheath. b, Shows the two chromic gut interrupted sutures in both muscles. This procedure ends Step 4.

it materially in performing its function of maintaining the support of the pelvic and abdominal organs. According to Frank (2) these fascia blend at the anterior border of the puborectalis portion of the levator ani.

The coccygeus muscles are two small triangular muscles that fill in the gap posteriorly between the spine of the ischium, the sacrosciatic notch and ligament, and the coccyx.

The next structure of importance in the anatomy of the perineum is the trigone or triangular ligament. This is a fibrous membrane attached to the bony boundaries of the anterior segment of the pelvic outlet. It is triangular in outline. Its base stretches across from each tuberosity of the ischium in front of the anus, its apex is attached to the pubic arch and subpubic ligament, and its sides to the descending rami of the pubis in front of the puborectalis muscle and sheath with which it is in intimate contact. This membrane consists of two layers between which runs the deep perineal muscle. There are two openings in the trigone—the urethra and the vagina—to which each is intimately connected, and to them it gives support.

It can readily be seen that the trigone plays an important function in the support of the urethra and vagina and gives secondary aid to the levatores ani muscles in maintaining its usefulness as a lower abdominal diaphragm, and perineal support of the anterior segment of the pelvic outlet.

THE MECHANISM OF BIRTH PERINEAL INJURIES

In a normal delivery following complete dilatation of the cervix and rupture of the membranes, the presenting part of the fœtal ovoid is propelled downward by expulsive voluntary abdominal contractions and uterine contractions to the pelvic diaphragm. That part of the fœtus which comes first in contact with this structure is rotated anteriorly directly under the pubic arch, and this acts as a fixed point or fulcrum. By a continuation of the expulsive forces, the posterior portion of the presenting part is propelled in an upward and outward direction, distending the posterior segment of the pelvic outlet and gradually thinning out the pelvic diaphragm, and produces a bulging of the perineum. This is the beginning of the perineal stage. As labor

progresses the presenting part appears at the vulva outlet and the structures of the anterior segment of the pelvic outlet (puborectalis muscles; trigone and other perineal muscles) are gradually more distended at each expulsive effort until the presenting part is born.

In a normal delivery where there is no disproportion between the fœtus and pelvic outlet, and in a patient possessing elasticity of the puborectalis muscles and triangular ligament, delivery can be accomplished without damage to these structures. Superficial lacerations, nevertheless, may occur that do not interfere with the integrity of perineal support.

However, instances exist many times in which there is disproportion between the fœtus and pelvic outlet in varying degrees. In order to overcome this obstacle, and for delivery to take place spontaneously, it is necessary for the expulsive pains to be of greater force and over a longer period of time. Under such circumstances inertia frequently occurs and the accoucheur resorts to forceps to accomplish delivery. The posterior segment of the outlet, as pointed out by Klein (3) and later by Williams (4), is markedly encroached upon and great distention of the perineal structures occurs in order to accomplish the desired end. Deep lacerations usually take place, at times in the median line through the trigonum down to, and occasionally through, the sphincter ani, producing a complete laceration. More often there are lacerations laterally in the vaginal sulci, which may or may not involve the puborectalis muscles.

In elderly primipara and among the athletic types of women, the perineal structures may be unresisting and non-elastic. Lacerations of the perineum frequently occur with this class. Median or lateral periniotomy, however, may prevent a severe or awkward laceration.

During the course of any delivery, an emergency may arise that makes it imperative to terminate labor by forceps or version before the presenting part has reached the perineum and without the preliminary softening and thinning out of the pelvic floor. Under such circumstances deep lacerations are common—involving the puborectalis muscles and triangular ligament, and often through the sphincter ani.

When the puborectalis is lacerated through, the site of the tear is usually along its insertion into the rectum. Instances are related where the muscle has been torn from its point of origin behind the symphysis pubis. I have never seen such a condition and the recognition of such an accident would be very difficult to determine.

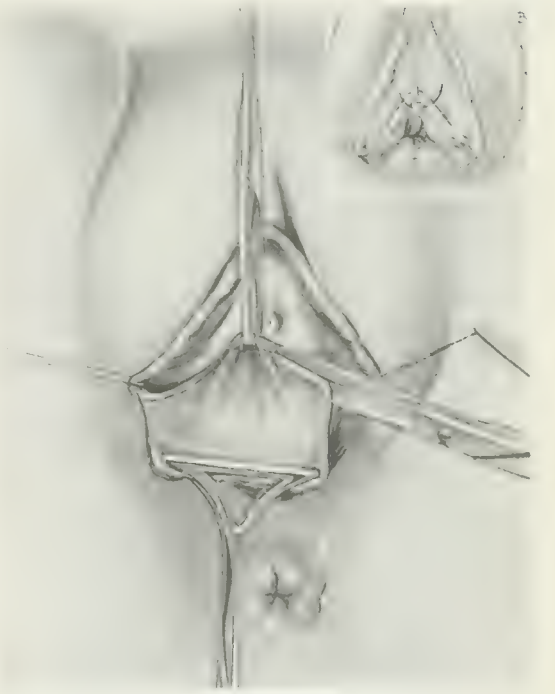

Fig. 3. a, Shows method of excising excess of vaginal mucosa. b, Shows beginning of submucous suture.

When perineal lacerations occur, the primary suture of the injured structures, if done anatomically and under proper conditions, will, in the majority of instances, prove successful in its repair. Unfortunately the proper environment and aid are frequently lacking when attempting this operation. Therefore, failures occur often.

Following an improper suturing of the lacerated puborectalis muscles or muscle, and a similar injury to the triangular ligament, we have a union, as a rule, of the vaginal mucous membrane and, if the perineal skin has been sutured, union has taken place there. The edges of the puborectalis, however, have retracted laterally from its rectal insertion, allowing the rectum to protrude through the posterior vaginal wall. Improper union of the triangular ligament in a similar manner causes a relaxation of the structures that depend upon it for support, then follows an eversion of the vagina, and relaxation of the vaginal outlet and a general lowering of tone of the whole perineal body.

Another class of cases includes the women who have had numerous deliveries in a short space of time; one child follows the other before complete perineal involution has occurred. When such a condition exists the puborectalis muscles and the

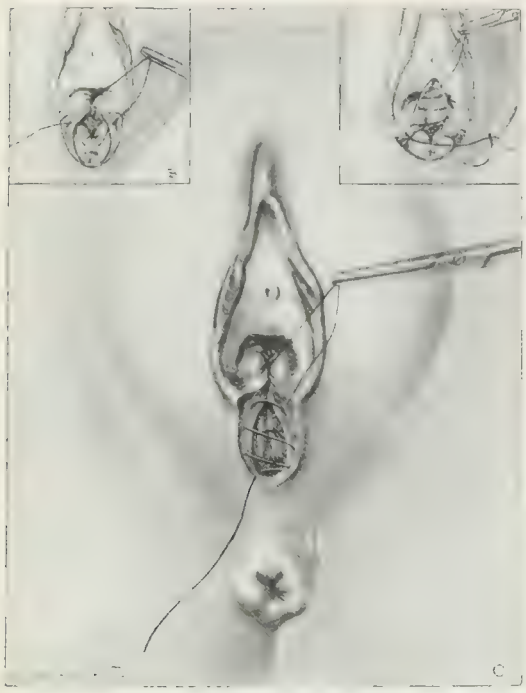

Fig. 4. a, Showing the submucous suture completed. b, Shows previous suture pulled tight with approximation of mucous membrane edges and with same suture of catgut, the placing of suture through the angles of the triangular ligament and mid portion of the approximated puborectalis muscle. c, Showing continuous suture of the triangular ligament to its lower angle. Completing steps 6 and 7.

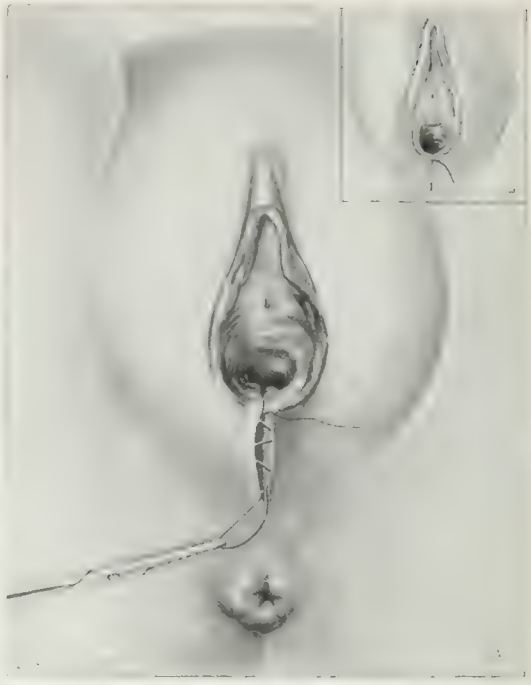

Fig. 5. a, Placing of subcuticular suture from lower angle of skin wound to the mucous membrane. b, Shows suture made taut with approximation of skin edges.

triangular ligament become stretched and thinned out, and separated from their insertion, and their normal elasticity and anatomical relationship become lost and distorted. This results in a general relaxation of the entire pelvic outlet, producing rectocele, eversion of the vaginal outlet, and protrusion of the vaginal mucous membrane. Other pathological conditions may also arise, such as cystocele, retrodisplacements, and partial uterine prolapse.

THE TECHNIQUE OF PERINEAL REPAIR

The modern operation for perineal repair was originated by Haynes in 1908 (5), who described a technique in which he localizes the anterior muscular bundle of the levator ani muscles (puborectalis) and approximates them by suture in the mid line anterior to the rectum. Further interrupted skin perineal sutures approximate the edges of the triangular ligament. Since that time many modifications and improvements upon this original technique have been described.

The following operative technique is one used by the author in over 50 cases with most satisfactory results.

Step 1. Patient in dorsal position with legs in stirrups. Place towel clamps or suture at the mucocutaneous junction of the vulva at openings of the Bartholin ducts. Make traction upon the clamps so producing a horizontal line between these two points.

Step 2. Grasp the mucocutaneous junction with mouse-tooth forceps and, with curved scissors, cut away a strip of skin and mucous membrane between each fixed point. This separates vaginal mucous membrane from the skin perineum.

Step 3. Make sharp scissors dissection of vaginal mucuous membrane taking particular care to have it very thin without buttonholing it. When a sufficient amount has been dissected from the underlying structures, place two triangular clamps upon it to facilitate further dissection. From now on, if a line of cleavage has been found, blunt gauze dissection of the vaginal mucous membrane is carried out to the dome of the rectocele, usually a distance of 1.5 to 1.75 inches.

Step 4. Make lateral gauze dissections of mucous membrane behind the descending rami of the pubis, in order to expose the puborectalis muscles and sheath. The edges of these muscles can be brought into view by placing index finger in the denuded area and pressing downward and backward upon the anterior rectal wall. We now have exposed the denuded flap of vaginal mucous membrane above; below, the anterior rectal wall; and laterally, the edges of the puborectalis muscles and fascial sheath situated behind the descending rami of the pubis. Place two interrupted No. 2 chromic gut sutures through these muscles and tie, thus approximating the muscles in the mid line anterior to the rectum. If any undue tension is present after tying sutures, this can easily be relieved by partially separating them bluntly from their attachment to the rami of the pubis.

Step 5. Excise Λ-shaped portion of the excess of vaginal mucous membrane and approximate edges by a continuous submucous suture until the cutaneous junction is reached. This suture is of No. 2 chromic catgut and over 20 inches long, and is used to complete the remainder of the suturing to be done. There is now a space bounded posteriorly by the approximated levator muscles, above by the approximated vaginal mucous membrane, and anteriorly by the cut edges of the triangular ligament and skin perineum.

Step 6. To obliterate this dead space and bring the normal relation of the triangular ligament in contact with the levator muscles and sheath, the suture is passed through the upper left angle of the triangular ligament, then through the mid portion of the approximated levator muscles, and through the right upper angle of the triangular ligament. By making this suture taut the desired effect is accomplished.

Step 7. The same suture now approximates the edges of the triangular ligament with several bites until its lower angle is reached.

Step 8. The same suture now approximates the skin perineum, beginning at the lower angle using it in a subcuticular manner back to the mucous junction where two slip knots are made, burying them beneath the mucous membrane.

SUMMARY

1. The structures injured at the completion of the second stage of labor producing subsequent relaxed perineum, rectocele, are the pubococcygeus muscle bundles of the levatores ani, their fascial sheath (rectovesical and anal fascia), and the triangular ligament.

2. In order properly to correct the disturbed anatomical relationship of the puborectalis to the rectum, it is necessary to approximate them with their fascial sheaths in the mid line anterior to the rectum.

3. To restore the vulva and vaginal support which depends upon the triangular ligament, it is necessary to shorten this structure and place it in close contact with the levator muscle and sheath.

4. The operative technique described above fulfills these conditions in that it re-establishes the perineal structures in their anatomical relation.

5. The use of a submucous suture in approximating the resected vaginal membrane prevents pain from tension and irritation from a leucorrhœal discharge that always follows the absorption of sutures taken through the mucous membrane. The subcuticular suturing of the skin perineum also prevents tension upon the skin, and precludes the possibility of infection through needle openings.

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A NEW SPLINT FOR FRACTURES OF THE FOREARM[1]

By H. A. McKNIGHT, A.B., M.D., Philadelphia
Assistant Professor of Surgery, Pennsylvania Post Graduate School; Surgeon, St. Mary's Hospital

FRACTURES of both bones of the forearm are the most poorly treated of all fractures in the body. The methods of splinting now used have been in vogue for many years, and while known to be inadequate, have never been improved upon. The late war taught us an efficient and easy method of splinting fractures of the lower extremity, and as a result we have discarded to a large degree the older methods. The Liston splint, Buck's extension, and many of the cumbersome and unwieldy forms of apparatus advocated by the German surgeons have been supplanted by the more modern splints of wire and steel rods, and for weight and adhesive traction we now use direct bone traction by means of the tongs and the Steinmann pins. The war has also taught us that it is not necessary to bind up a fracture in boards with an artistically arranged bandage, and has dispelled the old misplaced complacency we formerly felt in a fine appearing external dressing. For fractures of the upper extremity, and especially those of the forearm, we have no adequate and efficient traction splint. For forearm fractures the anterior and posterior straight board splint is our only generally recognized dressing.

Fracture of both bones of the forearm is a rather common injury, occurring as it does in about 8 per cent of all fractures. Brun reports out of a total of 8,560 fractures, 752 of the forearm or about 8.7 per cent; Chudowsky of a total of 2,366 reports 125 fractures of the forearm or 5.32 per cent; Immelman in 2,048 fractures reports 7.5 per cent of the forearm, and Plagman reports 9.62 per cent. This fracture, therefore, is common enough to merit more attention in treatment than it now receives. It occurs in the young most frequently, the deformity is usually a lateral or backward angulation, the dorsal surface of the forearm forming an obtuse angle, and the ventral surface forming the salient angle.

Reduction under general anæsthesia, even when checked up by the fluoroscope, is most difficult. The muscular masses are out of proportion to the size of the underlying bones, the muscular pull is in many diverse planes, the bones are small and the ends are usually pointed or oblique. The radius is especially difficult to engage; it is usually fractured in an oblique manner, and even though it is reduced, to keep it in position with wooden splints and without traction is next to impossible. There is no fracture where the ultimate resort to operation is so frequent or where the results are so poor. As the bones are so near to the skin surface, infection is very frequent, plates loosen, and deformity occurs.

The splint I have devised for this fracture is a metal tube splint. It is an ambulatory dressing. It is light in weight and is inconspicuous. The posterior two-thirds is made of light tube steel with two lateral arms and a posterior cross piece. The anterior one-third is made of a steel rod, the anterior end of which is expanded into a large ring. The rod fits into the tube portion of the splint like a sliding trombone and can be extended by two screws or turn-buckles traveling on the threaded anterior portion. A removable aluminum shield is clamped to the tubing and is set at such an angle that it impinges on the anterior surface of the upper arm with equal pressure at all points. The hand is tied to the expanded circular anterior portion of the splint by means of cords fastened to the fingers of a glove buckled about the wrist. The shield, well padded, is applied to the anterior surface of the upper arm, which has been flexed to a right angle, and held with adhesive plaster. The turn-buckles are then tightened, and traction and counter-traction are maintained with the arm in full supination.

If it is desirable to dress the arm in the mid-position midway between supination and pronation, a small rod is dropped into a ring on the anterior part of the splint at right angles to the horizontal plane of the splint, and the cords are attached to this rod.

The same splint may also be used for fractures of the humerus when dressed in full extension.

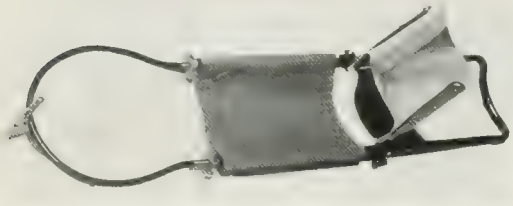

Fig. 1. Photograph of splint.

[1]Demonstrated to American College of Surgeons, Philadelphia, October 25, 1921.

Fig. 2. Splint applied to arm.

For this class of cases, the shield is removed and the expanded anterior section of the splint is fitted over the shoulder and a heavy pad placed over the acromion process. The glove-encased hand is attached to the posterior cross bar and the splint is extended by the turn-buckles. The arm may be maintained in this position under constant traction until reduction is obtained, and then the more comfortable position of flexion may be used. As the point of fixation, when the splint is applied in this way, is a bony one there is no danger of pressure on either nerves or blood vessels, as occurs in splints with a crutch attachment and where the point of pressure falls in the axilla. The splint is held in place by swathes which are placed about the chest and neck.

Fig. 3. Arm flexed

The advantages of the splint are that—

1. It is light and comfortable.
2. It leaves the part open for massage and inspection without disturbing the constant traction.
3. Constant graded traction is maintained at all times and can be increased or decreased by the patient if too uncomfortable.
4. The progress of the traction can be watched by the X-ray.
5. It can be used for more than one type of fracture.
6. All points of pressure are free from nerves and blood vessels.
7. It is inexpensive and durable.

THE DIRECT STIMULATION OF PERIPHERAL NERVES

Rules for Procedure in the Operating-Room

By HENRY O. FEISS, M.D., Cleveland, Ohio

IN a previous work in collaboration with two others,[1] a brief report was made on peripheral nerve injuries as studied during the recent war. In that report mention was made of the fact that during the operations on these nerves, they were almost always tested for faradic excitability. No detailed account of the method was given at that time, but owing to the fact that considerable interest has recently been awakened in certain operations applying to spastic paralysis, especially as carried out by Stoffel, the writer offers the following account of the method which was used by him on hundreds of wounded men, while he served in a neurological capacity at the American Ambulance before and after its militarization by the U. S. army. His experience is, however, not derived from the operating-room alone, but is also based upon certain experimental data obtained previous to the war.[2]

In stimulating nerves in the operating-room, one soon learns to establish a definite routine which resolves itself into a set of rules. No doubt there are certain deficiencies in those used by the writer, but they are presented for what they might happen to be worth and as they were actually carried out.

Rule 1. After a most careful dissection of the nerve, the surgeon should free it for a sufficient distance, depending in the individual case upon the conditions found locally in and about the nerve, but care should be taken not to "strip" the nerve clean for any greater distance than is absolutely necessary, as such a procedure injures the circulation in the sheath of the nerve.

Rule 2. During the unavoidable manipulation by the surgeon in attempting to isolate the nerve from the scar or other adherent tissues, responses might be evoked owing to the mechanical stimulation thus brought about. These should be carefully observed[3] all through the operation because the effects of mechanical stimulation of a nerve are of the greatest importance, especially when they are positive. Their importance lies, first of all, in the fact that one need not consider anything analogous to the escape of current, which complicates the use of electrical stimulation, as the stimulus is conveyed only by the one nerve handled. In the second place, these responses (obtained by mechanical stimulation), give us a very clear notion, from the point of view of conductivity, of the precise functional state of the nerve as well as of the muscles which it supplies because of the extreme delicacy of the test.

Rule 3. Before faradic stimulation, the nerve previously freed should be lifted up on a nonconductor hook, a glass hook being very useful. The object of this is to isolate it from all other tissues. If, however, the nerve is found divided, the advisable technique is to take a suture through the end of the segment to be stimulated and to lift it up in that way.

Rule 4. During the act of stimulation, the nerve should be kept moistened with warm salt solution. This is easily done by having the assistant moisten a sponge with the solution, squeezing it out drop by drop over the structure tested. Not too much solution should be dropped into the wound for fear that the nerve will lie in a bath of fluid, thus promoting spread of current.

Rule 5. For faradic stimulation, the bipolar electrodes are usually considered more practical than the unipolar ones (whereas in stimulating cortical areas, unipolar electrodes are better). The electrodes should be of metal all the way through, so as to be easily sterilizable. The points themselves had better be of platinum and should be constructed so that the distance between them may be altered with ease. It was found expedient to have the two platinum wires entirely free for a distance of about 1.5 centimeters, so that the distance between their free ends could be adjusted by simply bending the wires.

Rule 6. It is perhaps best to start with a current of only moderate strength. A strong current is dangerous on account of spread and should be used only on occasions where a weak or a moderate current has been previously tried. A good procedure is to test the current before the operation by applying the electrode points to the tip of one's tongue, a current which just begins to be

[1] Majors G. E. Price, H. O. Feiss and Lieutenant Terhune. Peripheral nerve injuries. Arch. Neurol. & Psych., 1919, 1, 547-559.

[2] H. O. Feiss. On the fusion of nerves. Quart. J. Exper. Physiol., v, No. 1.

[3] In all this work, the extremity of the limb to be operated upon should be as carefully sterilized as the field of operation, because it is necessary to expose the fingers and hand, or the toes and feet, in order to watch for responses in them.

perceptible, being a good current to start with on the nerve. This having been done, the relationship of the secondary coil to the primary coil is noted and maintained for the beginning of the operation. For thick nerves such as the sciatic or where there is much scar, a stronger current will be required, in order to insure that the inner central fibers are engaged in carrying it.

Rule 7. Stimulate the nerve on all its sides and if there is a neuroma, stimulate above and below the neuroma, as well as in the course of the neuroma itself. Remember, however, that the interesting portion of the nerve for efferent fibers is the segment peripheral to the lesion. For afferent fibers, the central segment is more important and one looks for responses in the pulse, respiration, pupils, skeletal muscles, etc.

Rule 8. If the response for efferent impulses is positive, the surgeon should attempt to separate the nerve into its constituent bundles and to test each bundle, one at a time. In this way he may be able to obtain precise information as to which part of the nerve has escaped injury or has regenerated. The surgeon should also examine the neuroma with the same object in view; namely, to see if there are any tracts which are excitable or conduct impulses.

Rule 9. It is important to note the precise nature of the responses; it is not enough to say whether the response is positive, but it is also necessary to describe accurately what the response is. For example: In stimulating the musculospiral nerve above the elbow, note whether the wrist extends and whether there is an extension of the fingers and thumb. More than that, note how great and how powerful the movement is. In stimulating the median nerve just above the wrist, this rule is of the greatest importance because the normal responses here are only of the thumb and two fingers and are not great in their extent, whereas, more central stimulation evokes responses which are more extensive and powerful. In some cases the muscles and their tendons contract, but bring about no movement of the joints to which they apply; this is owing to mechanical resistances as occasioned by contractions or ankyloses.

In stimulating the sciatic nerve, the interpretation may be difficult. If plantar flexion takes place in the ankle it must be the effect of stimulating fibers in the internal popliteal nerve. But we cannot infer from that, that the external popliteal nerve is out of commission because frequently the muscles supplied by the internal popliteal nerve have greater power than those supplied by the other. In order to determine the true condition of excitability in these two branches, one must either first separate them completely or stimulate each separately, well below the bifurcation.

Rule 10. The writer has usually started with slow interruptions in the current, not only because the effect of excitation may be better studied, but also so as to avoid fatigue. This rule is, however, subject to modification, and as it is known, from experiments on the vagus nerve, that some of its fibers respond better to certain given rates of interruption, it is perhaps better in some instances to try different rates of interruption.

Rule 11. If it is decided to exsect the neuroma, which is often found connecting the two segments of the lesion, it is of interest to study the extremity during the actual exsection because this act is nothing more or less than a form of mechanical stimulation. Therefore, when this is to be done one should be prepared to observe the effect; the neuroma should first be cut off from the central segment and secondly, from the peripheral segment. This may reveal a peculiar condition of conductivity in the neuroma. Occasionally it is found that on stimulating the peripheral segment, responses are obtained which were not obtained on stimulating the central segment. According to most physiological opinion, this means that fibers have grown down from above (in the central segment) and have indirectly connected with the peripheral segment through the scar tissue around the lesion.

It goes without saying that observations as made in the operating-room are valuable only if a careful examination of the part has been made beforehand and the last examination should have been made only a few days before the operation. If this is done, the data derived from direct stimulation of the nerve are adaptable to comparison with the data obtained previously by stimulation through the skin and should, of course, confirm these findings. Should there be any discrepancy, the data obtained by direct stimulation are to be considered the more accurate. But if the two sets of data correspond, then the whole set of findings becomes immensely more valuable.

INDUCTION OF LABOR BY THE USE OF CASTOR OIL AND QUININE

A Report of Three Hundred Cases[1]

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THE attempted induction of labor by the use of castor oil and quinine is one of the commonest procedures in obstetrics. It is harmless, so that if it fails there is nothing amiss; if successful, labor has been inaugurated easily without undue distress to the patient or relatives and a more troublesome method of induction has perhaps been avoided. Occasionally it seems that abortions are brought about by the use of these same drugs. As early as 1890, Atkinson (1) in a court case, wherein it was contended that quinine had been the responsible agent for the abortion, asserted that there was some evidence for the assumption that quinine has an oxytocic effect, but that cinchona alkaloids had no fixed and definite action on uterine contractions, except in certain cases which appeared to have an idiosyncrasy toward the compounds.

Two cases have come under observation in which I feel that quinine and castor oil were responsible for the abortions. One case was that of a primipara 3 months pregnant. She took 60 grains of quinine sulphate over a period of 6 hours. She had marked signs of cinchonism and aborted with extreme pain, but at the end of the third day seemed to have recovered from all ill effects of the experience. The second patient was a multipara, 4 months pregnant. She took an ounce and a half of castor oil and forty grains of quinine. Her pains were sharp and she had profuse vaginal bleeding, suggesting an early separation of the placenta before the os was sufficiently dilated to allow the passage of the fœtus.

METHOD OF EMPLOYING THE DRUGS

The patients are allowed a light dinner and in the case of primiparæ, the oil is given at midnight, in multiparæ, at 6 or 7 o'clock in the morning. These hours are purposely chosen, for administration at such times usually means that the cases will be delivered during the daylight or seasonable hours. The oil, an ounce and a half, is given with orange juice or some other vehicle of a similar nature, to enable the patient to take it easily. A hot enema, 116° F., is administered as soon as the oil is effective. Directly after the enema, quinine sulphate is started in 5-grain doses, at 30-minute intervals and continued until 20 grains have been ingested. If the patient at any time complains of ringing ears or nausea, the drug is immediatly stopped. Usually if the quinine is given with a grain of pepsin there is no nausea. In a few of the cases reported, the quinine was given in 10-grain doses beginning with the effectiveness of the oil and then 2 hours later. I do not believe that the results justify the use of the drug either intravenously or intramuscularly. If the attempt failed, a second trial was never made until 10 days later. The age of the patient played no part in the question of the attempted induction.

	Age	Successful	Unsuccessful
Primipara	18–30	60	80
Multipara	21–43	80	80
Total		140	160

In the unsuccessful cases, all were due by date except 20 primiparæ, and the heads were fixed in all cases but 8. The induction was attempted early either because of a moderately contracted pelvis or an impending toxæmia. Of the multiparæ, all the cases were due by date with the exception of 28. The heads were not fixed in 20 cases, but the induction was employed for an impending toxæmia or because the case seemed well over due, even though the dates did not correspond.

DISCUSSION OF CASES

It will be noted at once that the percentage of successful induction is 46.6 per cent. This result corresponds closely with that of Muschallik (2) who reports 58.6 per cent in 155 cases using the drugs by mouth, and 52.2 per cent in 50 cases where the quinine was used intravenously and intramuscularly. It will also be noted that the positions and presentations apparently play an unimportant and negligible part so far as success is concerned.

There were 20 cases of fulminating labor, 4 primiparæ and 16 multiparæ. These cases, together with the number ending in operative deliveries, emphasize the fact that castor oil and quinine induction is not without its dangers. All patients were carefully observed in labor, and the fœtal heart counted at regular intervals. We immediately interfered at the first appearance of

[1] From the Department of Obstetrics, Western Pennsylvania Hospital, Pittsburgh, Pennsylvania; Clinic of Dr. Paul Titus.

fœtal or maternal distress. By fœtal distress we mean any change in the character of the fœtal heart, any sudden continued rise or fall in the count per minute, or any discharge of meconium per vaginam in presentations other than breeches. The term maternal distress is too evident to demand elaboration.

Among the unsuccessful cases, one, a primipara 20 years old, with the cervix partially taken up and the head fixed, deserves special mention. After the ingestion of 15 grains of quinine sulphate, she had marked aural and visual disturbance. Her uterus contracted at intervals, the pain being severe enough to distress and keep her from resting. The uterus did not relax well between pains and fœtal distress was apparant. The contractions lasted over a period of 4 hours, and the noteworthy facts were that as soon as the contractions ceased, the fœtal heart promptly became normal again and the cervix showed no change from that at the beginning.

This last fact is of interest because it bears directly on the question as to whether quinine in its action on the uterus ever has any effect on a closed cervix.

In the successful cases the noteworthy facts were: (1) the patient was due or past due by dates; (2) the head was fixed or was beginning to engage; (3) the cervix was partially or completely obliterated and the inner os would admit a finger; (4) the uterus was irritable and would easily contract under manipulation.

ACTION OF QUININE

The question immediately arises as to whether quinine is an oxytocic and acts directly on the uterine muscle or not. Clinically, for many years past, quinine has been used and still is used in uterine inertia, stimulating the uterus in some cases and failing in others. It is occasionally prescribed in menorrhagia but with no fixed results. Fischer (3) in discussing the use of quinine in malarial pregnant women, questions whether the drug has ever caused an abortion in such cases. He believes, however, that in non-pregnant women it may cause too frequent periods and excessive flow at regular periods. In the few patients he has treated with quinine for menorrhagia, the results have been gratifying but the few cases do not warrant the drawing of too definite conclusions.

The exact innervation of the uterus is not altogether definite. It has been repeatedly demonstrated in the laboratory that if the pregnant uterus is excised and then placed in Ringer's solution or any other physiological solution, the temperature kept constant at 37° C., labor will go on spontaneously until the end, even though the organ lacks all body connections. Cases are frequently reported, in which there are grave injuries to the spinal cord. Such patients have a noteworthy labor due to the fact that they experience no sensation of pain. A patient of this type was recently seen on the service, 7 months pregnant. She had a motor and sensory disturbance below the tenth thoracic, due to a transverse myelitis. She had no knowledge of the fact that she was in labor until after the fœtus had delivered. Such evidence makes it impossible to doubt that the intrinsic nerve supply of the uterus is sufficient to carry on labor independently of other external nerve supply. We cannot lose sight of the fact, however, that there must be a connection with the sympathetic system, for it is admitted that extreme emotion may profoundly influence the course of labor either by way of acceleration or retardation.

Guggenheim (4) has brought out an interesting fact concerning the effect of quinine on the uterus. He used uteri excised from rats for his experiments, placing them in Ringer's Solution kept at body temperature. When quinine was added to the solution he demonstrated two facts, namely: there was a definite increase in the tonus and rhythm of the contractions if present, though no contractions could be initiated if not already in action; the os, if not open and patulous, would remain unchanged no matter how long the fundus muscles contracted, in other words, a long cervix, closed and not taken up, would not be effected by the drug. This bears directly upon the question as to whether quinine can initiate labor or influence the condition of the cervix.

The most recent work has been done by Acton (5). He was especially interested in women who

	Time of Onset, Labor	Length of Labor	Cases
Primipara	2½ to 19 hours Average: 6 hours	6½ to 19 hours Average: 11 hours	60
Multipara	2 to 11 hours Average: 3 hours	2 to 11 hours Average; 6 hours	80

	Spontaneous Delivery	Forceps	Version	Pituitary Extract	Position			
					L. O. A.	L. O. P.	R. O. A.	R. O. P.
Primipara	32	28 { 20 Fœtal distress; 8 Delayed Second Stage	0		10	4	12	4
Multipara	66	8 Fœtal distress	1	5: D.S.S.	52	12	12	4

were malarial and desired to know the effect of quinine medication upon the pregnant uterus. To make the conditions of the experiment conform as closely as possible to those existing when the drug is taken by mouth, the quinine was used in alkaline solution. It is probably true that the drug is carried in the alkaline bloodstream as a weak base and utilized as such, hence in experimenting an alkaline solution of the drug should be used. The experimenter took 5 grains of quinine sulphate by mouth and at the end of an hour found that the quinine concentration in his blood was 1:378,000 and at the end of two hours, 1:750,000. This fact would afford an accurate comparison in the use of experimental quinine. A quinine solution of 1:42,500 introduced into the Ringer's solution, containing the excised pregnant uteri, caused violent contractions, almost tetanic in character, while in a solution of 1:150,000 merely increased the tonus and rhythm of the contractions without any untoward effects of overstimulation.

In labor, the longitudinal muscle fibers of the upper segment act as a driving force in expelling the fœtus from the uterus, and synchronously with this contraction, the circular muscles of the lower uterine segment are relaxed and stretched to allow the head to pass through the low narrow segment of the uterus. In all his work, Acton noticed an effect of the quinine upon the muscle groups, but the os remained closed and unchanged and in exactly the same condition as it was before the addition of the drug. His conclusions are that concentrations of 1:150,000 increase the intermittent uterine contractions and if some exiting cause, such as a patulous or dilated os be present, the pressure brought by the increased contraction, in an already irritable uterus having slight contractions (the usual condition of uteri at or near term), it might be sufficient to cause the onset of active labor. He does not report the initiation of contractions if they were not already present. Such experimental work would lead one to believe that quinine is an oxytocic although it does not seem to have the power of initiating contractions. From a comparison of the experimental concentrations of quinine used and the concentration in the blood when the drug was taken it would seem that 20 grains taken at intervals by mouth would be sufficient to bring about the necessary concentration in the blood for definite action upon the uterus.

ACTION OF CASTOR OIL

Among the cathartics castor oil is one of the mildest. It has a definitely irritating effect upon both the large and the small intestine. As far as inducing labor is concerned, its direct action is questionable. The most probable explanation is that, in the irritation of the whole gastro-intestinal tract, it brings about peristaltic increase through its local action on the bowel. It may be parenthetically noted here that quinine also has a local irritating effect upon the intestinal tract. The disturbance from the increased peristalsis is transmitted to the sympathetic centers of the system controlling the intestinal tract. The uterine center, if there be such a thing, is situated near the other low sympathetic centers and is either directly or indirectly affected, thus setting up the beginning contractions in a near term and irritable uterus. This explanation is reinforced by the observation that severe diarrhœas in pregnant women frequently initiate labor. Probably the irritation of the castor oil starts the uterine contractions, the quinine then reinforces through direct action on uterine muscle steadying the rhythm and increasing the tonus.

CONCLUSIONS

1. Quinine and castor oil, in inducing labor, are successful in approximately 50 per cent of cases.
2. Labor should be carefully watched, for occasionally there may be tetanic contractions. At the first sign of fœtal or maternal distress, the operator should be ready to interfere.
3. If there are signs of cinchonism, the quinine is to be stopped at once.
4. The most favorable conditions for this type of induction are: when the estimated date is due or past, when head is fixed or beginning to fix in pelvis and when the uterus is irritable.
5. The mechanism is due to irritation caused by the castor oil on the sympathetic centers with increased peristalsis and a reinforcement of the rhythm and muscle tonus by the quinine acting directly upon the uterine muscle bundles.

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ULCERS ON THE POSTERIOR WALL OF THE STOMACH AND DUODENUM[1,2]

Symptoms, Diagnosis, Technique of Operation

By MOSES BEHREND, M.D., F.A.C.S., Philadelphia

NO case of ulcer on the posterior wall of the stomach that came under our care was diagnosed as such until operation. The patients had symptoms of ulcer of the stomach, but the location of the ulcer was not accurately determined until operation. The symptoms of ulcer on the posterior wall of the stomach are not so well defined as are those of ulcer on the anterior wall. In cases of ulcer on the posterior wall, operation can be postponed longer than in cases afflicted with ulcers on the anterior wall or lesser curvature of the stomach. On account of this delay, ulcers on the posterior wall become much larger than those found in other parts of the stomach; they are not so freely movable and because of their adherence to the contiguous structures, their removal is much more difficult.

The diagnosis of ulcers on the posterior wall of the duodenum presents the same difficulty in formulating a diagnosis as to location as do those found on the posterior wall of the stomach. In the former the symptoms are more marked and the patients seek operative relief earlier. While it is not of paramount importance to know the exact location of an ulcer before operation, still one must be conservative regarding the prognosis after operation for ulcers on the posterior wall of the stomach and duodenum because such ulcers require more extensive operation and this entails greater risk.

The tissue surrounding an ulcer on the posterior wall of the stomach is usually so involved that at operation it is often impossible to tell whether the condition is benign or malignant. We have in a few instances pronounced ulcers malignant at operation, when much to our surprise the pathologist has reported them benign. Unquestionably cancer may follow ulcer of the stomach and of the duodenum but the writer has never observed a malignant ulcer of the duodenum or carcinoma engrafted on a duodenal ulcer. Cancer of the first portion of the duodenum is admittedly a rare occurrence, cancer of the second portion is more common, but not nearly so prevalent as cancer of the stomach. The occurrence of cancer engrafted on ulcer of

[2] Research work performed at the Bauch Institute of Anatomy, Jefferson Medical College. Clinical work performed at Jewish and Mt. Sinai Hospitals.

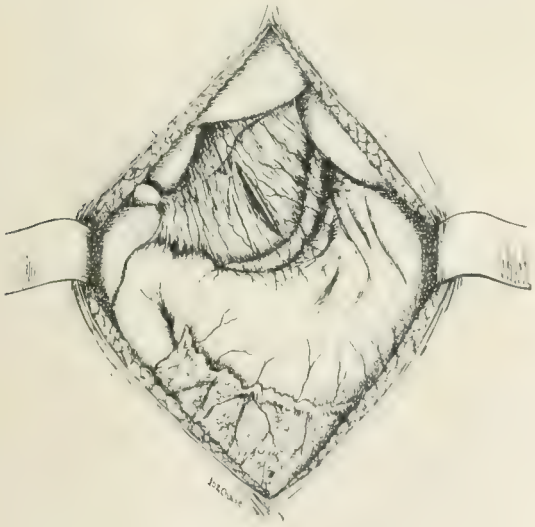

Fig. 1. Gastrohepatic omentum has been incised.

Fig. 2. Posterior wall of stomach has been delivered. Ulcer and portion of wall being excised with cautery.

[1] Read before the Philadelphia County Medical Society, October 12, 1921.

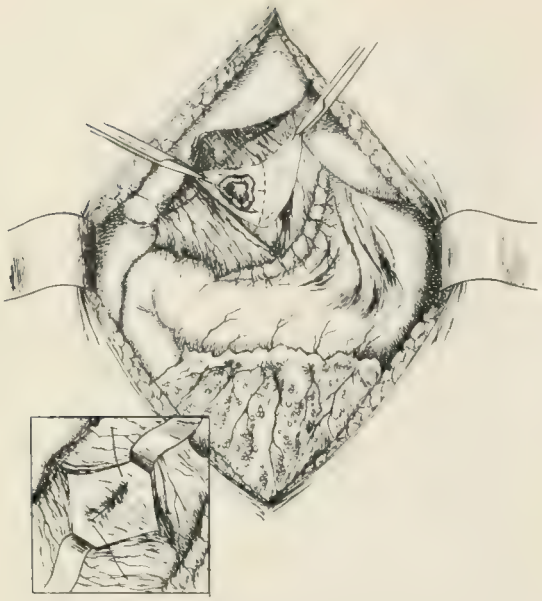

Fig. 3. Excision is almost complete. Insert shows stomach sewed opposite to the incision.

the stomach varies according to different observers. The range is from 7 to 62 per cent.

The X-ray discloses many ulcers on the lesser curvature and the anterior wall of the duodenum, and the method is fairly accurate, but this is not true in locating ulcers on the posterior wall of the stomach. Even with the patient in the lateral

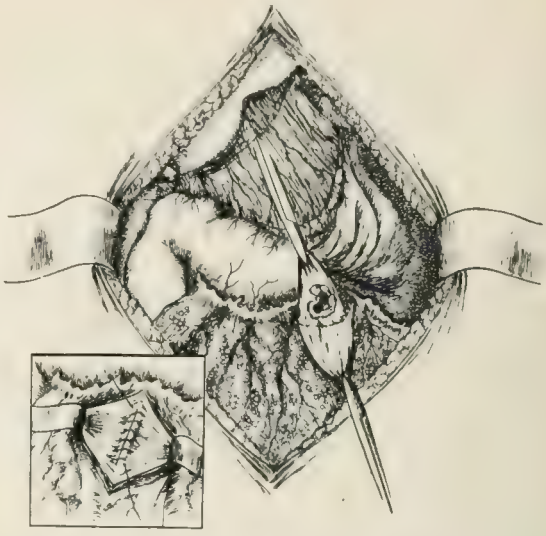

Fig. 5. The ulcer has been nearly all excised. Insert shows stomach sewed in the opposite direction to the incision.

position, except in a few cases, it is impossible to detect an ulcer on the posterior wall of the stomach with the X-ray.

As stated, the symptoms of ulcer on the posterior wall of the stomach do not differ materially from those on the anterior wall. The characteristic symptoms of "indigestion," pain immediately after eating, vomiting, and hæmatemesis usually stamp the condition as one of gastric ulcer.

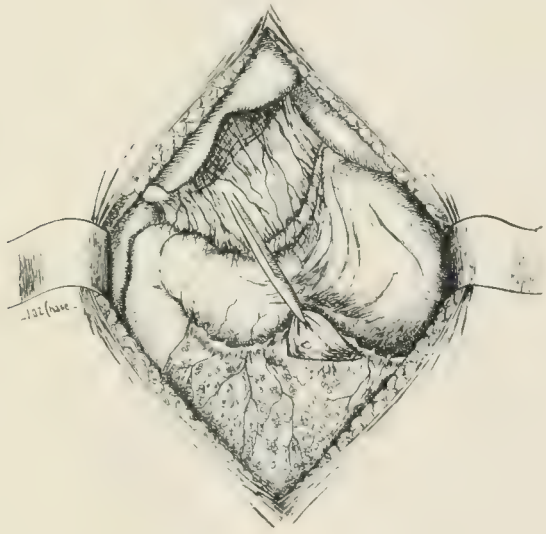

Fig. 4. The gastrocolic omentum has been opened. The ulcer-bearing portion of the posterior wall of the stomach has been delivered.

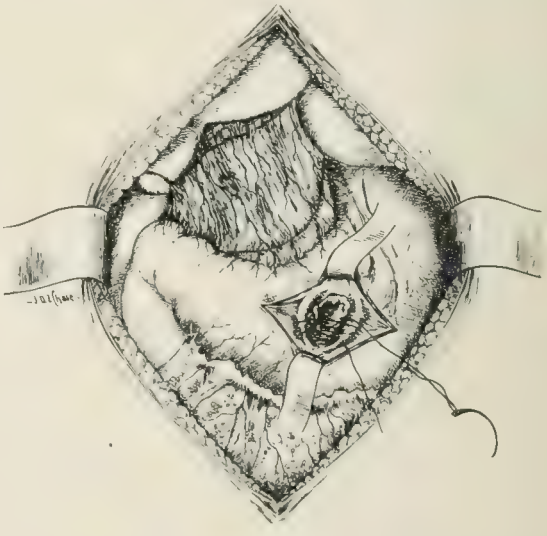

Fig. 6. Transgastric method of attacking an ulcer on the posterior wall of stomach. Note Lembert sutures in mucous membrane which, completed, cover the ulcer.

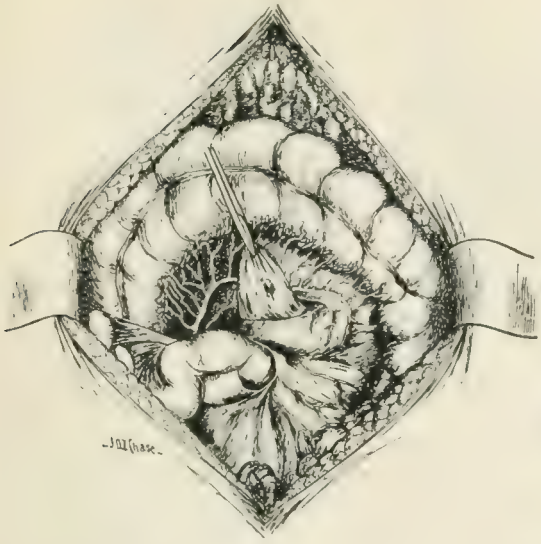

Fig. 7. The transverse mesocolon has been incised and ulcer, with posterior wall of stomach, has been delivered.

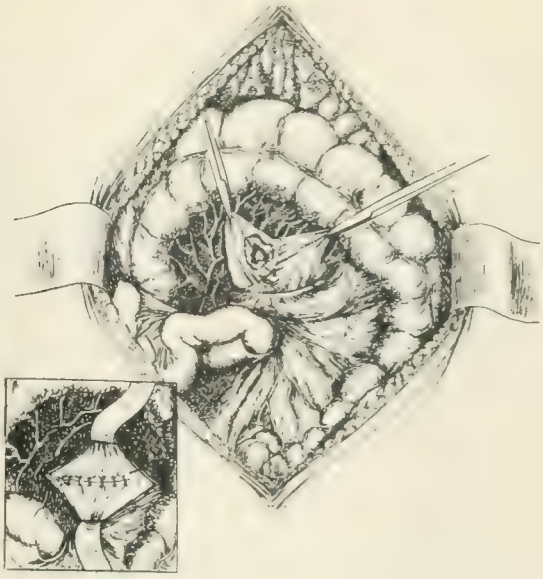

Fig. 8. Excision almost complete. Insert same as above.

The cardinal symptoms of duodenal ulcer do not differ even if the ulcer is situated on the posterior wall of the duodenum. Pain an hour or two after eating and relief after taking food are characteristic.

The diagnosis between ulcers of the stomach and duodenum and gall-bladder disease is simply mentioned to remind one of the possibility of mistaking these affections one for another.

ULCERS ON THE POSTERIOR WALL OF THE STOMACH

Ulcers on the posterior wall of the stomach may be approached from several anatomical landmarks. Some prefer attacking the ulcer through the gastrohepatic omentum (Figs. 1, 2, and 3); others select the gastrocolic omentum (Figs. 4 and 5), while the transgastric (Fig. 6), and transverse mesocolon routes (Figs. 7 and 8), may be the choice of other surgeons. In the writer's experience, it is not possible to treat all cases alike; some may be more easily removed by going through the lesser omentum, others again may be more easily removed through the greater omentum. If the ulcer is not adherent to underlying structures, the routes just mentioned are to be preferred, but if we encounter an ulcer that is firmly plastered to the parietal peritoneum, pancreas, and other vital structures, the transgastric operation has a distinct field of usefulness.

Briefly, the superior route consists in the following steps: The gastrohepatic omentum is incised, the right hand being employed to push the stomach upward until the ulcer is reached. The ulcer is then removed by means of the cautery, the stomach is sewed in the opposite direction so as to prevent encroaching too much on its lumen (Figs. 1, 2, 3, and insert). In the inferior method the gastrocolic omentum is incised, and the method of procedure is reversed, the left hand being used to push the stomach downward, and the ulcer is treated as mentioned before (Figs. 4 and 5). One of the best methods of attacking ulcers in this situation is the route through the transverse mesocolon. Here we follow practically the same procedure that one uses in performing a gastro-enterostomy. In performing operations in this situation, extreme care must be taken not to injure the middle colic artery.

The last method is preferable at times to the other two just mentioned because it affords ample room in which to work (Figs. 7 and 8).

The transgastric method of treating ulcers of the posterior wall has given considerable satisfaction. It is absolutely necessary at times to use this method on account of the close adherence of the ulcers to the posterior parietal peritoneum and contiguous structures. An incision is made on the anterior wall of the stomach, the edges are retracted, and the ulcer plicated, being completely covered by at least two rows of sutures.

Fig. 9. The duodenum has been mobilized and clamped. (Ochsner.)

Fig. 10. The stomach has been mobilized and clamped. A pursestring has been used on the duodenum, the stump has been inverted. (Ochsner.)

Fig. 11. The ulcer-bearing area has been removed. (Ochsner.)

This method has given us some of our best results. The patients have rapidly increased in weight. One patient must be mentioned particularly as he gained 25 pounds in weight and returned to the hospital as an orderly.

A gastro-enterostomy has never been performed after an operation for an ulcer on the posterior wall of the stomach. It is not necessary because the lumen of the stomach is not encroached upon to any appreciable extent. After the ulcer is removed the stomach is sewed in the plane opposite to the incision in the stomach.

ULCERS ON THE POSTERIOR WALL OF THE DUODENUM

Ulcers on the posterior wall of the duodenum are not so easy to handle technically as those on the anterior surface. Ulcers on the anterior wall

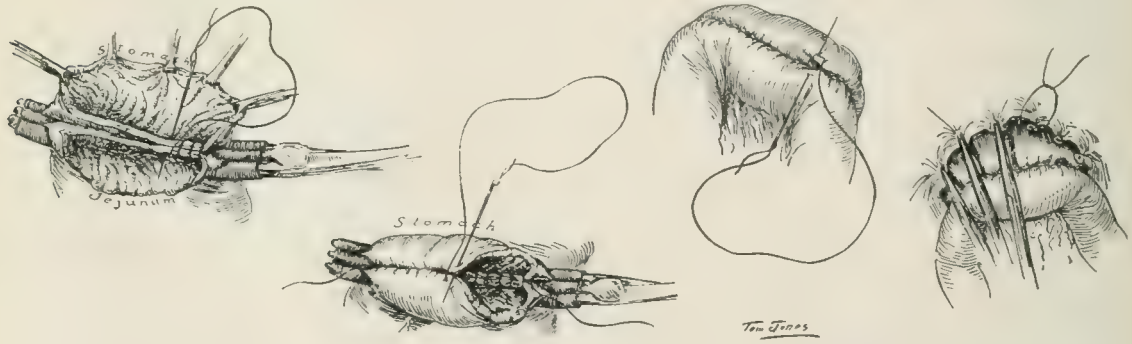

Fig. 12. By means of a three-bladed clamp a posterior gastro-enterostomy is performed. (Ochsner.)

Fig. 13. The completed operation. (Ochsner.)

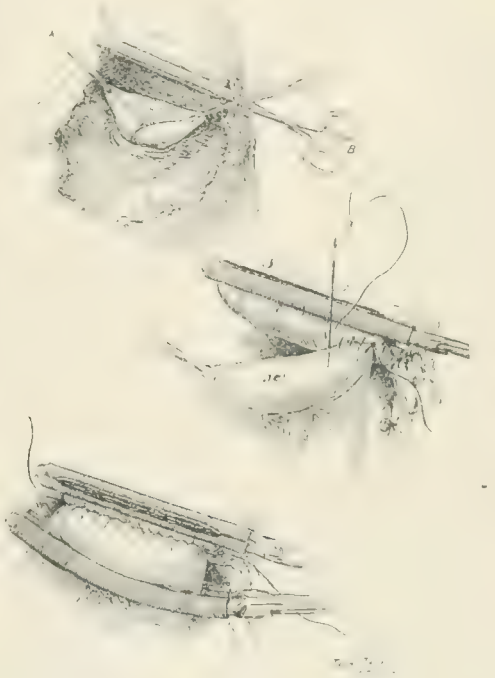

Fig. 14. Bringing the jejunum to the cut end of the stomach as in the Pòlya operation. (Ochsner.)

can be excised readily and the cut edges brought together. On the posterior wall, however, on account of more or less fixation to the underlying structures by means of the peritoneum, together with the added inflammation, an excision of the entire ulcer-bearing area, is, to my mind, the procedure of preference. I have used the technique described in an article by Ochsner in the *Surgical Clinics of Chicago*, October, 1919. While the illustrations show the ulcer nearer the pylorus than the duodenum, the various steps of the operation are performed in a similar manner. In the first illustration the duodenum is mobilized, then clamped above and below the ulcer-bearing area. The diseased portion is then excised by means of the cautery, the distal and proximal ends are closed, a purse-string suture is placed about an inch from either end, and then the sutured ends are inverted, the purse string is pulled taut, and a few running sutures close the remaining aperture. In some cases when the ulcer encroaches on the stomach itself, it may be necessary to mobilize the stomach to a considerable extent, and, instead of performing a posterior gastro-enterostomy, the jejunum may be brought up through an incision in the transverse mesocolon or over the transverse colon and attached to the cut end of the stomach anteriorly. This is commonly known as the Pólya operation (Figs. 9 to 14).

Another method of treating the open ends is to perform an end-to-end anastomosis of duodenum and stomach, but I believe the best results will be secured if one of the foregoing procedures is followed. After operation on the duodenum, a posterior gastro-enterostomy is always performed, unless end-to-end anastomosis is done, or possibly some other technique such as the Finney or Horsley operation.

CONCLUSIONS

Greater accuracy should be sought in the diagnosis of ulcers on the posterior wall of the stomach and duodenum.

The surgeon must be prepared to treat ulcers on the posterior wall of the stomach by any one of the various routes outlined. A gastro-enterostomy is not necessary following these operations.

Ulcers on the posterior wall of the duodenum are best treated by an excision of the duodenum and pylorus followed by a gastro-enterostomy, a pyloroplasty or a gastroduodenostomy.

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SURGERY, GYNECOLOGY AND OBSTETRICS

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JUNE, 1922

THE PANCREAS IN SURGERY

HOW many surgeons who operate on the abdomen are always careful to feel of and, if possible, to look at the pancreas, especially when they are operating for gall stones or duodenal ulcer, or the like? The pancreas is the most deeply seated, and if not the most important, at least the most complicated in functions and relations of all the abdominal organs. It is loose in structure, irregular in development, lies in a deep and protected position, and varies in size and relations. The casual variations in the development of its ducts are many, so that plugging of the duct of Wirsung by a stone in the ampulla may block it up entirely or the duct of Santorini may take up the work and no harm result to the pancreas except for the entrance of bile, which however, may do harm enough by causing an acute pancreatitis. The head of the pancreas in a certain proportion of cases surrounds the common bile duct, so that a moderate swelling of the organ causes jaundice, which will not result if the duct, as in normal cases, runs along the border of the head.

Who that does not familiarize himself with the feel of the normal pancreas knows anything about the tumors caused by a localized chronic swelling in the head; about pancreatic cysts, which may be quite extensive in the interior of the organ, without much outside projection; about early cancer of the pancreas? Doctors Deaver and Sweet seem to me to have made out a good case for the causation of what the surgeon calls chronic pancreatitis (which is nothing more or less than an inflammatory swelling of the organ, usually limited to the head, and lasting a varying time according to the persistence of the cause) by extension from the gall bladder or other infections, and for the treatment by removal of the gall bladder, or more rarely of other sources of infection. But if, through inadvertence or carelessness, the gall bladder be removed in a case of cancer of the pancreas, when sooner or later we are going to need it for cholecystogastrostomy for the relief of jaundice, more harm than good has been done. Cysts of the pancreas are not benefited by such treatment, nor is the swollen head of the pancreas which accompanies sometimes a stone in the common duct.

In general, in jaundice cases, when the surgeon is uncertain whether the swollen head of the pancreas is blocking the duct or whether an infection is the cause, the gall bladder would better be drained than removed, unless it is too thickened and contracted, when the duct must be drained. Long-continued, intractable, chronic pancreatitis, or swelling of the pancreas requires cholecystogastrostomy for its relief, just as much as cancer of the pancreas, and here also there is a prospect of cure. So we must be very careful, if the gall

bladder be in a suitable condition for use in drainage in these cases, not to remove it, but drain it, as Archibald has suggested; whereas, in the early non-jaundice cases, removal of the gall bladder is the best treatment of which we know.

With the real chronic pancreatitis, known to the pathologist, and its two varieties, interlobular and interacinar, the surgeon has little to do. It is noteworthy that in the interlobular variety the pancreas is hardened, nodular, and contracted instead of enlarged. The process is one of scirrhosis of the ramifying fibrous framework, a scirrhosis resembling in many ways scirrhosis of the liver. In the interacinar variety the scirrhosis involves the finer ramifications of fibrous tissue, between the ultimate glandular elements, and here again the organ itself is not enlarged. This variety by involving the islands of Langerhans is a very common cause of diabetes, but again it does not concern the surgeon.

Acute pancreatitis and pancreatic abscess, fat necrosis, peripancreatic hæmorrhage—how much are these relieved by gall bladder drainage? Sometimes this is successful, but rarely is the arrangement of the ducts such as to render gall bladder drainage efficient in draining the bile or other infected material from the pancreas. Here in addition to bile drainage, we should never neglect scoring the peritoneum over the organ, incision of abscesses, and free drainage. The fact that gall stones frequently accompany and may even cause acute pancreatitis makes it by no means certain that their removal will cure it. It is aggravating to learn of the removal of gall stones in a patient with swollen pancreas, when the surgeon says that the pancreas varies so in size that it may be within normal limits, and then learn that the patient died in a day or two of acute pancreatitis without any attempt being made at direct drainage.

The surgeon who does not familiarize himself with the normal pancreas and then with its various pathological manifestations, does not look for fat necrosis and soft spots, and high tension in acute cases, and for the underlying cause in chronic cases, is neglecting his patients, and will occasionally lose a valuable life. This field into which so many rush, with the carelessness bred of ignorance, is one in which experience, study, and care are of the greatest importance and where carelessness, ignorance, and bad judgment meet their destined but pitiful reward.

Fred B. Lund

PERFORATIONS AND THE "FATAL IMPROVEMENT"

MANY truths accepted in theory are difficult to put into practice. Circumstances which concern the practical aspects of the life and social conditions of the patient, over which the doctor has no control, influence thought and action, so that what the science of medicine might accomplish for the patient in a given case may be limited.

We accept the theorem that early operation for perforation of a viscus is necessary to save life. On the platform before medical societies we assume that the question is not debatable, but at the bedside we waver. Uncertainty of diagnosis, the timidity of the patient, and the prejudices of the family, may render presentation of the desirability of early operation unconvincing. Owing to overstrong emphasis on the necessity for early operation, the patient may be placed in the hands of an irregular practitioner or a Christian scientist is called; the patient recovers, (there are perhaps three chances in four that recovery will take place as a natural process), and the restoration is attributed to the services of the

cult exponent. In approximately 75 per cent of cases of acute, subacute, and protected perforations the patient eventually recovers, but 25 per cent is a terrific death rate. The morbidity in these cases and the probable necessity for later operations to effect cure are also grave considerations.

Prognosis is a fine art. Human judgment is fallible and the physician's dilemma too often depends on a frail clinical decision. The most frequent and misleading cause of failure to insist on immediate operation is what might be termed the "fatal improvement" which develops with the patient's reaction from the shock of the perforation. When acute perforation occurs, a group of symptoms develop which are readily recognized; they are pain, vomiting, muscular rigidity with the knees and thorax flexed, anxious expression, and increasing pulse and temperature, resulting in a condition of shock, during which intestinal peristalsis is stopped. In a few hours, reaction from this condition takes place, and under the influence of the anodyne usually given, the patient becomes fairly comfortable. The abdominal rigidity, however, in the cases of serious perforation remains constant. The escape of septic material into the peritoneal cavity causes a temporarily localized contamination of a limited field. In the asthenic condition which immediately follows the catastrophe, the contamination, except as it is carried by the escaping material, remains in the vicinity of the perforation. With the reaction, intestinal movements again begin, the septic material is spread, and the safe time for operation has passed. The reactionary improvement too often leads the attending physician to an unwarrantably favorable prognosis and delay which results in a fatal termination.

Perforations of the appendix are the most common. In the majority of persons the mechanical conditions around the appendix are favorable for localization. Even when the appendix is located in the pelvis the resultant infection may be limited by the epiploic tags of the sigmoid and omentum, and a septic accumulation involving the entire small intestinal area below the transverse colon may effectually be localized. The pelvic peritoneum through age-long exposure to infection has acquired a remarkable power of resistance which is not shared by the peritoneum of the upper part of the abdominal cavity. To reach the general circulation from the lower half of the abdomen the infective material must pass through the portal circulation of the liver, the great organ of protection. From the upper half of the abdomen the infected material passes into the mediastinal spaces and reaches the general circulation direct, resulting in the complicating bronchopneumonia which so often is the immediate cause of death in cases of septic peritonitis. This is particularly true of the central tendon of the diaphragm through which solid particles may pass. Perforation of the duodenum often causes a limited contamination, as the amount of septic material that escapes may be small and relatively sterile. The escaping material often gravitates into the right iliac fossa. In many such cases the appendix is removed, libelled by the statement that the infection has passed through normal mucous membrane. However, the patient often recovers in spite of an unneccessary appendectomy and in the presence of duodenal perforation.

Perforations of the stomach are less favorable from the standpoint of prognosis than those of the duodenum; the quantity of escaping material may be large and contain septic particles of food, which by gravitation to the unprotected diaphragm, results in early general sepsis. The surroundings of the stomach are such that attempts at encap-

sulation of the escaping contents are liable to be ineffectual or may lead to the development of a subdiaphragmatic abscess.

Perforation of the gall bladder into the free peritoneal cavity is often fatal, not from inherent causes, for bacteria which have passed through the liver to reach the gall bladder are greatly reduced in virulence, but because, as a rule, the gall-stone attacks so closely resemble the attack that ends in perforation that they are attributed to gall-stone colic and the patient is allowed to drift for some days before the real difficulty is recognized.

Simultaneous perforations of the gall bladder and appendix are rather common. The rule is that the patient has gall stones. An acute infection of the appendix permits the passage of bacteria into the portal circulation and the gall-stone-infested gall bladder rapidly becomes involved. In a large percentage of such cases the infecting organisms belong to the colon group, and cause a foul fæcal odor; in these cases the appendix should always be examined for coincident perforation.

Frankness in dealing with the patient, the family, and the friends, is the wise policy. When those interested understand the slight risk of operation in the early stage, and that the responsibility for delay must be borne by them and not by the physician, they, as a rule, become amenable to reason.

William J. Mayo.

THE TREATMENT OF CHRONIC MALIGN DISEASES OF LYMPH GLANDS

CHRONIC malign diseases of lymph glands are protracted contests between bacterial or neoplastic parasitic cells, acting upon the offense either separately or in combination, and the tissues of the host reacting upon the defense. The unaided powers of defense are never adequate to produce spontaneous recovery. However gradually one of these diseases may begin and progress and however effectively the defensive reactions may intermittently check its advances or even induce temporary regressions, if the process is malign for the individual affected the end-result is the same. Eventually a progressing incapacity of sources of reserve powers of resistance, which are resident in the hæmatopoietic structures, is caused by prolonged toxæmia. Henceforth increasing disability and death are inevitable.

Three types of diseases are in this category: granulomata (tuberculosis), neoplasmata (carcinoma), and the group intermediate between granulomata and neoplasmata (Hodgkin's disease, leukæmia, lymphosarcoma, etc.). All three have much in common. They become established only in susceptible individuals, i.e. those having some biological deficiency. Their modes of offense and the defensive responses provoked are similar or identical. Their ultimate effect upon untreated patients is the same. Their two great points of difference, etiology and histopathology, are of little consequence to the afflicted who are in need of permanent symptomatic relief.

The present general dissatisfaction with the results of treatment is largely attributable to misconceptions of the pathogeneses involved. Too much attention has been focused upon the morbid process and too little upon the patient's defense. A combination of the two, offense and defense, constitutes disease, the control of which is the real problem to be solved.

Seeking for "cures" of malign diseases is scarcely more rational than Ponce de Leon's search for the fountain of youth. A cure means an elimination of a malady so complete as to preclude all possibility of a recrudescence. Facts now established prove that

cures of tuberculosis are in reality but symptomatic recoveries because living tubercle bacilli persist and are demonstrable postmortem no matter how perfect or how prolonged a recovery may have been. Likewise it is known that recrudescences may occur after long intervals of latency during which there has been faulty presumptions of cure. It is becoming more evident that similar conditions obtain in cancer and in diseases of the Hodgkin's type and that actual cures of these maladies are not only rare but no more satisfactory than symptomatic recoveries. Latent periods of 30 and of 11 years have been noted in cancer and Hodgkin's disease respectively and many cures have been erroneously proclaimed after shorter intervals of symptomatic relief. Pursuits of mythical panaceas have obscured possible attainments with methods at hand. Malign diseases can be converted into benign diseases at least temporarily. The duration of the periods of benignancy is determined by both the degree of malignancy, or the relative preponderance of powers of disease offense over individual defense at the time treatment is begun and by the thoroughness of the treatment.

If treatment is to provide every opportunity for lasting recovery, three accomplishments are prerequisite: first step, an elimination of the portal of entry or of the initial lesion; second step, a material subtraction from the bulk of the disease (lymphoma), and, finally, the third step, an increase in defensive powers of individual to highest possible level, which level should be permanently maintained.

The methods in vogue to accomplish the first step are extirpation, cauterization, and radiation. Each has its advantages under certain conditions. In general, clean excisions are the more certain to be effective, to permit of the smoothest healing and to interfere least with the third step.

The methods being used in the second step to combat the lymphomata are excision, radiation, and various forms of heliotherapy. Excision is the method of choice if more than transient palliation is still possible.

Halsted has established the achievements as well as the limitations of surgery. Steps one and two can be accomplished in so far as securing permanent freedom from disease in the areas subjected to operation and no farther. These local or regional cures are assured only when the extirpations are complete, which means a removal of all lymph glands, gland-bearing and disease-bearing tissues within and just beyond the frontiers of the affected area. Thus has been proved the true conservatism in combatting malign affections, namely the utmost operative radicalism. There need be and should be no handicap to increase of resistance after these operations. On the contrary local and general resistance will be augmented by proper and prompt excisions. Such operations suffice to initiate improvement that can amount to recovery if step three be not neglected.

Radiation either by X-ray or radium is invaluable in treating certain initial lesions that cannot satisfactorily be excised or cauterized, and in reducing the size of lymphomata that cannot be extirpated. Defects in present radiotherapeutic methods have restricted the indications for its use at least temporarily. Emanations may fail to control and can even stimulate the activity in initial lesions. Disease processes within malign lymphomata can be modified but not destroyed by radiation, and sooner or later cannot even be controlled. Radiotherapeutic doses now generally held to be effective are injurious to the hæmatopoietic system. Consequently, if the lymphomata are benefited, general resistance is reduced and progress of the morbid process is ultimately fostered.

The question of postoperative radiation of areas excised can be answered. If the extirpation has been complete, radiation can only do harm; if it has been incomplete, transient benefits are conceivable.

Heliotherapy is of great value in after treatment because of beneficial effects upon both local and general resistance. Increased activity of erythroblasts and lymphoblasts is obtainable and invaluable, as is also local hyperæmia. The balance of after-treatment which must be persistent because the biological defect that makes the disease possible is as a rule inherent, if not inherited, includes all details that make for unusually healthful living. Methods employed in the treatment of tuberculosis suffice.

Better results follow as methods improve. The greatest obstacle to progress is therapeutic pacificism, usually called conservatism, by the blood-shy and those unwilling to see and to face facts. Earlier diagnoses are required, not so much of the exact nature of the affection but as to whether it is malign or benign. The more promptly a malign process is recognized, the less the degree of malignancy of that disease in the patient; and the sooner the most radical treatment warranted by conditions is instituted, the better the prospects for recovery. Few fatalities will result if benign diseases be treated as if they were malign. On the contrary procrastination in radical treatment of malign diseases condemns the great majority of patients to greater distress and danger if not to death.

The principles involved in exact methods of treatment need only to be understood to be accepted and applied. So long as a person is anatomically normal, physiological abnormality and disease is impossible. Morbid anatomical states assure morbid physiological processes. A restitution of normal or approximately normal anatomical conditions is the keystone of recovery and produces recovery in benign diseases. Successful treatment of malign diseases requires additional measures. The basic cause of these maladies is an unknown somatic weakness, and the secondary factor is the presence of parasitic cells which cannot as a rule be entirely removed or destroyed. Consequently there must be anatomical readjustment not to, but beyond normal—a compensatory lymphoblastic hyperplasia induced by extirpation, so there may be an overcorrection opposed to the inherent weakness. Surgical reconstruction is required to start recovery. Continued after-care to enhance and to protect general health is almost equally necessary to make that recovery permanent. J. L. Yates.

AMERICAN COLLEGE OF SURGEONS

SOUTH AMERICAN SURGEONS

REPORT OF OFFICIAL VISIT TO BRAZIL, URUGUAY, ARGENTINA, CHILE, PERU, AND PANAMA BY FRANCIS P. CORRIGAN, A.B., M.D., F.A.C.S., CLEVELAND, OHIO

IT is my privilege to report to the Fellows of the American College of Surgeons the present status of our Pan-American development. The movement to embrace the South American countries in this great guild, which is organized to elevate the standard of surgery, was inaugurated in 1920 by Dr. William J. Mayo and Dr. Franklin H. Martin. Dr. Martin, accompanied by Dr. Thomas J. Watkins and the writer, returned to the field in 1921. The present article is the third chapter of the story of this scientific inter-relationship.

The movement described as Pan-American had its birth in Faneuil Hall. The American Declaration of Independence and the succeeding world-stirring political events had its result in the present group of North and South American nations. They have in common the political ideal that governments derive their just powers from the consent of the governed. The first Pan-American manifestation was political. The leaders of the movement that brought about the independence of the South American countries, men like Simon Bolivar, San Martin, and O'Higgins, were practically all men who had been here personally or had at least imbibed the ideas of Washington, Jefferson, Franklin, and the other great founders of the United States. There was at that time and for many years thereafter a strong current of sympathy between those countries and the United States.

The second phase of the movement was commercial interchange. Commerce, although the life-blood of nations, sometimes carries in its current annoying parasites. The commercial relationship, in the main healthy, has too often been marred by individual selfishness.

The present phase of the Pan-American movement is cultural. It is characterized by interchange of ideas in art, literature, and science. It is interested in the beautiful and the true. It seeks by closer acquaintanceship to develop real friendship and to share useful information. For North Americans to understand South Americans, and vice versa, and thus approach real friendship, it is necessary that each divest himself in a measure of his own very different environment.

"In the United States the houses all have chimneys," was the unexpected answer I received from a resident of the tropics when I asked him what feature in the United States had most impressed him on his first visit. To the majority of Americans nothing could be more ordinary than chimneys on houses. To him it was a peculiar feature of the landscape.

I narrate this little incident to show how dissimilar environments may be and how essential it is for each to respect the other's point of view. If, therefore, one goes into these countries in a spirit of intellectual snobbishness, with the idea that one can learn nothing, it is certain that one will not be disappointed. It is equally certain that the intelligent, open-minded man will find much to admire and to imitate. For instance, the method of handling problems incident to tropical climates might be utilized with benefit in some of our hot Southern states.

The scientific bodies of North and South America have been rather diffident in their approach. Science is not as brash or as self-confident as commerce, because true science realizes its limitations and is duly humble. It may be for this reason that it has been well received.

Some idea of the influences now operating toward a genuine scientific reciprocity between North and South America might be gained by scanning the list of my fellow passengers on the SS. Aeolus which sailed from New York on February 2, 1922.

Dr. Richard Pearce of the General Educational Board, and Dr. Frederick F. Russell, director of laboratories, for the Rockefeller Foundation, were on their way to Brazil to "pass around any useful information that they might have." At least such is the description of the great work of the Foundation as expressed by its modest founder.

Specifically, these gentlemen were on their way to render such aid as the Brazilian government might desire in furthering the program of sanitation and medical education which it has under way.

Dr. Mark Boyd, an expert in malaria control, accompanied by Mr. Estus Magoon, a sanitary engineer, have been engaged by the Brazilian government to make a survey of the situation with regard to the elimination of malaria which is so prevalent in all tropical countries. Miss Clara L. Kieninger and Miss Louise M. Pitz, American nurses, formerly of the American Army in France, were going forth to another assignment on foreign land. These young ladies, selected by the International Health Board for the Brazilian government, are charged with the heavy responsibility of inaugurating a nurses' training school in a government hospital in Brazil. This is the first attempt to establish such a school according to American ideas, and much depends upon its success. Dr. Paulo de Proenca, a young Brazilian doctor, was returning, after spending two years in the laboratories of American universities, to take up his work in the Oswaldo Cruz Institute, the great research laboratory of Rio de Janeiro.

As representing interests other than medicine, I might mention Professor Edwin W. Kemmerer, of Princeton University, who was on his way to confer with representatives of various South American governments about currency and banking problems. Colonel C. C. Collier and his staff. Colonel Collier is commissioner general for the United States government to the exposition which is to be opened in September of this year in celebration of the Centennial of Brazilian Independence. The United States government has appropriated one million dollars toward this celebration, a part of which will be expended in the erection of an exposition building. This building is to be a permanent structure and after the exposition it will house the American Embassy. Our extensive participation in this celebration is not more than the repayment of a courtesy as Dom Pedro, then emperor of Brazil, was the only actual head of a government who personally visited our Centennial in Philadelphia in 1876.

Such are the influences which are bringing about between the two Americas a new era of understanding and friendship.

Rio de Janeiro, Brazil

At Rio de Janeiro, after a pleasant two-weeks' voyage, we were met by a committee of medical men who boarded our ship to greet us. This committee was made up of men interested in sanitary problems, medical men who came to meet the representatives of the Rockefeller Foundation, and surgeons (headed by my friend, Dr. José de Mendonça) who came to meet me as the representative of the surgeons of North America. Others of the committee were Dr. Carlos Chagas of the Oswaldo Cruz Institute, Dr. Oscar Clark, Dr. Hackett, and Dr. Bowman C. Crowell of the International Health Board.

The usual asperities and inconveniences of passing through the Custom House having been considerably ameliorated by our kind hosts, I was escorted to the very comfortable Palace Hotel by Dr. José de Mendonça, Dr. Oscar Clark, and Dr. Jayme Poggi. I will not attempt to describe the arrangements that were made for my entertainment, the pleasant hours spent, nor the delightful excursions which I made, accompanied by my kind hosts, to the many beautiful places around the bay, the wonderful botanical gardens, and other things with which my time was filled preliminary to our conference. I will say a word only of the new St. Francis de Assisi Hospital which is being rebuilt by the Brazilian government, and in which a modern nurses' training school, based on the principles of training schools in this country, is to be installed. This reorganization represents to my mind the beginning of a new era in the history of Brazilian hospitals.

I cannot forbear a few remarks about Corcovado, and the wonderful view which may be had from the top of that mountain. I can best describe it as an ideal place for a honeymooner and his bride where they may hold hands until the sun has set beyond "The Fingers of God," a mountain across the Bay of Rio de Janeiro, and watch the lights come on in the Cidade de São Sebastiao (City of St. Sebastian) as it is affectionately known to its citizens. This beautiful bay was named the "River of January" by the Portuguese sailors who first discovered it in the month of January. They erred in their belief that they were at the mouth of a great river. The city of Rio de Janeiro is strewn helter-skelter in the valleys between the mountains. The charm of Naples and Madeira is here magnified a hundred times. Besides being beautiful, the city is clean. On all sides it is bathed by ocean bayous. The many mountains among which the city lies are covered with virgin forests. The water wends its way from the mountains and is pure and soft. Since the elimination of yellow fever by Dr. Oswaldo Cruz, health conditions have been excellent. Infant mortality is still high but outside of this, the general mortality is comparatively low.

The formal conference of the Rio de Janeiro committee on credentials of the American College of Surgeons was called for 2 p. m., February 18, the day following my arrival. Dr. de Mendonça presided and Dr. Olympia da Fonseca acted as secretary. After I had completed the pleasant duty of extending the salutations and greetings of the Fellows of the College whom I represented, three points were brought up for consideration:

1. *The future of the College in Brazil.*
   a. Its numerical extension;
   b. Method for extending Fellowship to men in all sections of Brazil who meet the requirements of the College.

I told of our appreciation of the forces of Brazil and of our desire for a strong organization in that country. It was agreed that a movement should be started to secure the applications of as many as possible of the representative surgeons of Brazil. The committee in Rio de Janeiro agreed to enter into correspondence with eligible men and with the other committees already established in Brazil, urging them to take steps looking toward a healthy expansion of activities.

2. *The Cruise of the Fellows of the American College.* The proposed expedition to South America in February, 1923.

All who were present expressed their gratification and extended to the American College of Surgeons a hearty invitation. I informed them that their colleagues, the leading surgeons of the United States and Canada, would take advantage of the opportunity to participate in the Centennial of the Independence of Brazil, and that they would visit the Exposition, which will be a feature of that Centennial and in which our government expects to take prominent part.

3. *Prospects for hospital development and progress in Brazil.*

We discussed the hospital standardization program of the College. How was it being received and what steps, if any, were being taken to bring about its adoption? Their response was most encouraging. The Public Health Department of the Brazilian government is just completing the new hospital of St. Francis de Assisi. This hospital, as I mentioned above, will have a modern training school organized by competent American nurses. I have since had an opportunity to inspect the hospital which will be opened within a few weeks. While it is an old building which has been remodelled, on the whole it is very good. Dr. de Mendonça has prepared a complete program for the erection of four new hospitals of one thousand beds each which are to be located in four separate sections of the city. The plans for these hospitals conform very closely to our standard. This program has been incorporated in a bill which is now before Congress with every prospect of being speedily enacted.

In addition to the foregoing the Penitencia Hospital, which consists of a few old buildings which house about forty beds, is to be replaced by a two hundred and fifty bed hospital. The plans, which I have seen, are being prepared under the direction of Dr. Fernando Vaz, a Fellow of the American College of Surgeons, and, as he himself says, "half American." The Penitencia has an ideal location, and the monks who own it have in hand the necessary funds and the building will be under way in about two months. The institution will be a splendid one and Dr. Vaz contemplates organization along the most modern lines. If these plans materialize (and it appears that they will) the hospital situation in Rio de Janeiro will be revolutionized within the next five years. Dr. Vaz and his associates also have under construction a magnificent medical and surgical clinic in which they propose to institute group practice for their private work.

The surgical services in Brazil, as in all of South America, are organized by wards instead of by hospitals. Surgery on the Southern continent has been largely influenced by Parisian methods. It is the French system of individual artistry, as compared with the American system of team-work or group practice. The French method develops individual surgeons rather than a system of surgery.

On Wednesday, February 22, Dr. Russell, Dr. Pearce, and I were tendered a farewell *almoco* (breakfast) at the Jockey Club. Professor Miguel Couto presided and Dr. Chagas was toastmaster. Among the honored guests was Mr. Edward Morgan, the American Ambassador. About forty of the leading medical men of Rio de Janeiro attended. As indicating the spirit in which we were received, I quote verbatim from the address by Dr. José de Mendonça:

> Gentlemen: We have the honor to receive also as our guest Dr. Francis P. Corrigan, representative of the American College of Surgeons, a more recently organized institution than the Rockefeller Foundation, but no less useful to the health of humanity and to the progress of medical science. If the Foundation, wealthy and admirably directed, establishes medical missions, laboratories, hospitals, and medical colleges, and aids all useful things that have been accomplished in this line all over the world, the College visits, examines and advises, and, acting under its great scientific and moral authority, it encourages all institutions with which it comes into contact to develop their efficiency, and it awakens in them a useful competition which most assuredly will result in immense progress in medical science. The Foundation creates and organizes; the College educates, develops and moralizes.

Dr. Corrigan, this luncheon which is offered also to you as representative of the American College of Surgeons, signifies a hearty hand-shake from the Brazilian surgeons to their brothers of North America, to the prosperity of the American College of Surgeons, and to the good fortune of the Rockefeller Foundation.

With such messages ringing in our ears, Dr. Russell, Dr. Pearce and I departed from Rio de Janeiro on the night train for São Paulo.

São Paulo, Brazil

Arriving in São Paulo on February 23, we were met in the poetically named Estacão da Luz (Station of Light) by a large gathering of medical men, including Dr. J. Alves de Lima, chairman of our committee on credentials, and Dr. Benedicto Montenegro, secretary; also Lieutenant Tenorio de Brito, representing the president of the state, and Dr. José Lannes, representing the secretary of the interior.

São Paulo is situated at an altitude of nearly 3,000 feet, and the weather seems delightfully cool. Our visit was taken very seriously indeed. Representatives of both the Rockefeller Foundation and of the American College of Surgeons having arrived on the same train, good material was provided for the newspapers. I had notified the São Paulo surgeons by telegraph that I would arrive in their city on the morning of February 23, and they arranged a conference for the evening of that day.

We were escorted to our hotel by the committee, and in accordance with the hospitable custom which is in vogue everywhere in São Paulo, the greatest coffee state in the world, we all had coffee. At 3:30 in the afternoon we had an audience with the president of the state of São Paulo, Dr. Washington Pereira de Souza, a tall, handsome, distinguished looking man with gray moustache and imperial; also with the secretary of the interior, Senhor Alarico Silveira. States' rights obtain strongly in Brazil, and the important state of São Paulo has an almost independent government comprised of a president and a complete cabinet. The president of São Paulo is always a logical candidate for the president of the nation.

Before going to the meeting in the evening, I enjoyed a family dinner at the home of Dr. de Lima, whom I had met in Philadelphia. This dinner with Dr. de Lima and his family gave me a pleasant insight into home life in Brazil. The doctor has a charming wife, and six beautiful children all of whom converse fluently in English.

Dr. de Lima has a wonderful collection of plates, one from the great Napoleon's table, and other examples of the first products of Sevres and Delft. They are artistically distributed around the walls of the high-ceilinged dining room. On the walls of the living room, where we adjourned for our after dinner liqueur, was a collection of steel armor and weapons which belonged to the knightly ancestors of the family.

After dinner we went to the headquarters of the Society of Medicine and Surgery of São Paulo to meet with the committee. Dr. de Lima presided, and the following were present: Dr. Montenegro, Dr. Candido de Camargo, Dr. Rezende Puech, and Dr. Moraes Barrows. Dr. Meira Filho and Dr. Lindenberg were absent from the city, and Dr. Baetas Neves was confined to his bed. In general, the same things were considered as at the Rio de Janeiro meeting. The suggestion of expansion of activities brought up the question of division of jurisdiction between the São Paulo and Rio de Janeiro committees. Dr. de Lima suggested that São Paulo control the states of São Paulo, Santa Catharina, Rio Grande do Sul, Parana, Goyaz, Matto Grosso, and Minas Geraes, seven in all, leaving Rio de Janeiro in control of all of the northern states, fourteen in number.

Dr. Benedicto Montenegro, our very active and intelligent secretary, a graduate of the University of Pennsylvania, School of Medicine, was instructed to undertake the correspondence necessary to get into touch with the eligible men in other parts of the state of São Paulo. I was gratified at their genuine interest and enthusiasm for the work of the College, and the conscientious way in which they approached the problems. When told about the proposed cruise, the surgeons of São Paulo were very enthusiastic in extending an invitation to their North American confrères. I am sure many of the Fellows will take the interesting ride from Rio de Janeiro to São Paulo and then down over the wonderful silver-plated road to Santos. The trip will repay them for their efforts, and they will indeed be very welcome in São Paulo. There is considerable friendly rivalry between Rio de Janeiro and São Paulo, which results in a healthy competition. They will strive to outdo each other in their hospitality.

On the second day of my stay in São Paulo, after a trip to some of the hospitals of the city and to the famous snake farm, I was entertained by the Fellows of the College at an *almoco* in the Automobile Club. São Paulo's rapid growth has not been accompanied by a corresponding development of hospital facilities. The principal municipal hospital is lamentably overcrowded. In most of the wards, there are as many patients lying on mattresses spread on the floors as there are in beds. There is as yet no adequate plan for remedying this condition as there is in Rio de

Janeiro. The medical profession, however, is not to blame. It is simply another example of the weakness of the system of control by politicians over activities that should be supervised by technical experts.

Both Rio de Janeiro and São Paulo, the two leading cities of Brazil, have enjoyed a wonderful growth. São Paulo, which in 1890 had a population of only slightly more than 60,000, is now a city of nearly 700,000, while the population of Rio de Janeiro is now about 1,125,000. Industrial progress is also great. Before the war, Brazil depended entirely on Europe and the United States for manufactured articles. Bad conditions beget their own remedies. You can now buy clothes, shoes, sterilizers, bath tubs, plumbing goods and so on of native manufacture much cheaper than the imported article. Agricultural development is also proceeding rapidly. As a proof of alertness along this line, I heard that poison gas was now being used by the south Brazilian farmers to destroy termites and other insect-enemies. It would be strange if this terrible destructive agent might yet prove to be a great boon to mankind. Brazil is already a great manufacturing and exporting nation, and Rio de Janeiro is destined to become the New York of South America. The spirit of friendliness in Brazil for all things American was very marked.

Montevideo, Uruguay, and Buenos Aires, Argentina

I left São Paulo at 8:40 a. m. on February 26 and, after a most interesting ride over the wonderful railroad to Santos, which has been so well described by Dr. Martin, I embarked on board the Italian steamer "Principessa Mafalda," bound for Montevideo and Buenos Aires. During the few hours that our ship remained in Montevideo, I got into touch with Dr. Enrique Pouey, the chairman of the credentials committee for Uruguay. Without realizing the difficulties into which I was getting myself, I arranged with him for a meeting on Wednesday at 10 a.m., it being now Monday night.

Proceeding on the "Principessa Mafalda," I arrived in the busy harbor of Buenos Aires at about one o'clock the following afternoon, Tuesday, February 28. I went immediately to the Plaza Hotel, and after finding that the river boat for Montevideo was due to leave at 10 p. m., I proceeded to the telephone as I would at home, and got into touch shortly with Dr. Rodolfo Pasman, the secretary of our committee.

While waiting for Dr. Pasman, I thought to improve the time by looking up my passage back to Uruguay. I descended to the lobby and asked the hotel porter to secure my ticket and reservation back to Montevideo. "But have you a *cédula de identificacion* (identification seal)?" I learned that this was a necessary document without which I could not purchase a ticket to Montevideo and return. The Police Department was called—it was a holiday—Mardi Gras in fact. I was advised to go to the Police Department myself. I did so but came back empty handed with instructions to return at 4:30 p. m. Meanwhile, Dr. Pasman came along. After we had a talk about American College affairs, he accompanied me to the Police investigation bureau. Finally, after several trips, at seven o'clock in the evening, we got the necessary provisional certificate.

I learned from Dr. Pasman, and Dr. Robert Halahan whom I had known since the Montreal meeting, that it was vacation time and most of the men that I wanted to meet were still out of town. We arranged a conference for my return. So after nine busy hours in Buenos Aires, I started back across the Rio de la Plata on a speedy river ship called the "Cabo Corrientos."

I was received in Montevideo by Dr. Enrique Pouey who came to greet me and to welcome me to Uruguay. He announced that our meeting was arranged for 10 a. m.

At this meeting, which was held on March 1 in the Salon of the Hotel Lanata, practically every member of the credentials committee was present. I was given a rousing reception and literally greeted with open arms by a lot of splendid fellows. Those who were present at the meeting were Dr. Enrique Pouey, Dr. Alfredo Navarro, Dr. Manuel Albo, Dr. Julio Nin y Silva, Dr. Juan Pou Orfila. Dr. Pouey presided. We discussed in general the same subjects as were discussed at the other meetings. Afterward, I was taken for a drive around the city, through some of the beautiful boulevards and parks. One of the newer shore drives which leads out to the famous Pocitos Beach is called Avenida Woodrow Wilson. I also had an opportunity to visit the large general hospital which is the teaching hospital of the University. A striking feature of this group of hospital buildings is the new children's pavilion only recently completed. The walls are decorated with large mural paintings illustrating familiar nursery rhymes. It is a very pleasing departure from the conventional, plain hospital walls. We then returned to the hotel for an *almuerzo* with a larger group of Fellows.

At the hotel I was greeted by Dr. Garcia Lagos, who was still limping after a serious horseback

accident. This was his first time out since his accident and he pleaded his injury as his reason for not being the first to greet me, and he sent his regards to his many friends in North America.

We had a splendid meeting and all of the Fellows who did not attend sent formal regrets, giving reasons for their unavoidable absence.

Everything was pleasant in Montevideo; the doctors, the city, and most of all the warmth with which they received my news. They invited us with the utmost cordiality to visit them next year. They are all deeply interested in the College and they are a lot of fine fellows. It was with regret that I left this pleasant capital of the "Republic Oriental."

Buenos Aires. During my visit to Buenos Aires, I met with several members of the Surgical Society of that city. This is an honor society which limits its membership to recognized surgeons of good repute. In fact, I learned that the requisites for admission are very similar to those of the American College of Surgeons. Men possessing similar ideals must naturally be in harmony with the spirit of our great movement for the advancement of surgery.

In company with Dr. Pasman, I visited some of the hospitals. Many of the senior surgeons were still away on vacations. The surgical services were in charge of the younger group of men. I saw some very good work done by men of this group: Dr. Villegas, Dr. Pasman, Dr. Arano, and the younger Dr. Finochietto. They are the coming leaders of surgery in the Argentine, and form a very creditable representation for any country.

I had a most satisfactory interview with Dr. José Arce, who has recently been made rector of the University. Dr. Arce is the *Catedrâtico*, which means that he occupies the chair and is head of the department of surgery. I felt that he, therefore, was qualified to give the point of view of the surgical profession of Buenos Aires. He impressed me very favorably indeed. He is of fine appearance and gives one the impression of being a capable executive. In response to an inquiry from Dr. Arce, I explained to him our understanding of the Fellowship pledge of the College. I also told him that a large body of North American surgeons, leaders in their profession, were planning to come to South America next year; that they had been cordially invited by the surgeons of Brazil and of Uruguay; and I assumed that they would also receive a welcome from their colleagues in Buenos Aires, the metropolis of South America.

Dr. Arce said that he agreed with me entirely about the pledge, and assured me that he would call the surgical society together in April and that we could depend upon receiving a cordial invitation from the Argentine surgeons. The suggestion that a new pledge should be drawn up in original Spanish and not translated, as a literal translation does not always convey an identical meaning, is well taken.

After finishing my work in Buenos Aires I prepared to move on to Chile. The international train of the Trans-Andine Railroad runs only twice a week, leaving Buenos Aires on Wednesday and Sunday mornings. I still had a few difficulties to meet in Buenos Aires in the way of delay of consular visés and other technicalities incident to securing my permanent identification seal. I had only secured a provisional document for Uruguay which I had obtained under the promise that I would report back and finish the ritual for securing a permanent one before leaving the country. I will omit the details, but it is sufficient to say that they consumed much time and energy.

On Saturday morning before my departure I visited the British Hospital in company with Dr. Robert Halahan, a Fellow of the College. This is an excellent institution maintained by and for the English-speaking colony of Buenos Aires. Sir John O'Connor and Dr. Halahan are the attending surgeons. Dr. O'Connor was away at the time, but I had the pleasure of seeing Dr. Halahan do some skillful work.

During my stay in Buenos Aires, I was entertained by a group of surgeons at the famous Jockey Club, probably the most noteworthy club on this continent. Dr. Pasman also gave me a glimpse of Palermo and the race track and parks in that beautiful suburb. The police spoiled a luncheon that had been planned for me at El Tigre, the famous summer resort, as I had to spend most of the afternoon getting my *cédula de identificacion* so that I could leave on the Sunday morning train for Chile.

The Andes

At 8:30 Sunday morning I was off on the Trans-Andine Railroad, across the cattle strewn plains of Argentina. The scenery is rather monotonous after a few hours and there is little of interest until toward evening (the low grounds, immense flooded sections with billions of birds, ducks, flamingoes and others in endless variety).

I found the sleeper quite comfortable but was compelled to close the window on account of the almost suffocating dust. It was a rather trying night. Early in the morning, the train pulled into Mendoza, the wine center of Argentina. Here

we changed for the narrow-gauge road across the mountains. The Trans-Andine ride has been described by pens abler for the task. After an almost sleepless night it was something of an ordeal for me. It was extremely interesting, although I did not enjoy it as I should. I would advise anyone making the trip to break the journey at Mendoza or perhaps even higher up, rest for a day, and start afresh. It would be worth one's while. It is a wonderful journey, the descent on the Chilean side down the Aconcagua valley being especially interesting.

The train arrived at Los Andes at 7 p. m., one hour late. Los Andes is the Chilean terminus for the narrow-gauge road. The *Combinación* for Santiago and Valparaiso leaves at 8:15 p. m., so there is a rush and a hurly-burly to try and get your trunks past the customs inspectors in time to go to the near-by hotel for a bite to eat. We had had no diner on our train since lunch time, and as there is no diner on the *Combinación*, this was the only opportunity to secure food before Santiago at 11:30 p. m. By dint of effort and past football experience, I finally got my baggage through customs and had sufficient time for a hurried meal. We arrived in Santiago about midnight, and after a bath and a heaven-sent bed, I knew no more until morning.

Santiago

At Santiago, my first call was on the American Ambassador, Mr. William Miller Collier. In this connection I must express my gratitude to the State Department and the American Diplomatic and Consular representatives of the United States. They have always given splendid support and assistance.

Ambassador Collier was no exception. He arranged an appointment for two o'clock with Dr. Gregorio Amunátegui, dean of the Faculty of Medicine. He also honored me by making an appointment to present me to the president of Chile.

I met Dr. Amunátegui at his home and had a long conference with him. Dr. Amunátegui, who had been appointed chairman of the credentials committee in Santiago, arranged a meeting of the members of the American College of Surgeons for later in the week. This meeting was duly held at 4 p. m. on March 9 in Dr. Amunátegui's home. The following men were present: Dr. Gregorio Amunátegui, Dr. Luis Vargas, Dr. Eugenio Diaz Lira, Dr. Francisco Navarro, Dr. J. Valenzuela Basterrica. Dr. Amunátegui, as dean of the Faculty of Medicine, conducted the meeting, and it was characterized throughout by extreme frankness of expression. Some dissatisfaction was encountered because of the listing of a foreign mining colony with its surgeon, who was not licensed to practice medicine in Chile, at the head of the Chilean list in the year book of the College.

The opinion was expressed that a central committee with jurisdiction over the whole country of Chile would be more effective than one committee in Santiago and another in Valparaiso. Having been authorized from the headquarters of the College to make this change, the following central committee of seven members was nominated for the whole of Chile:

Dr. Gregorio Amunátegui, Santiago
Dr. Lucas Sierra, Santiago
Dr. Jerman Valenzuela Basterrica, Santiago
Dr. Luis Vargas, Santiago
Dr. Guillermo Muenich, Valparaiso
Dr. Edwyn P. Reed, Valparaiso
Dr. Alberto Adriasola, Valparaiso.

This plan and the nominations were afterward presented to the Valparaiso Fellows and agreed to by them. The reception in Valparaiso was very cordial. The meeting was held at the *Club Naval* and was attended by practically all of the Fellows residing in Valparaiso.

During my stay in Santiago, I visited three of the leading hospitals. These were all large hospitals of 700 or 800 beds with beautiful large patios filled with trees and flowers, presenting a very attractive appearance. The San Francisco de Borja, which I inspected with Dr. Luis Vargas as my guide, was especially attractive in this respect. Each of these large government hospitals has its own kitchen, bakery, laundry, etc., and is practically an independent village. In each there is a pavilion for private patients. The rates for *pensionistas*, as paying patients are called, is extremely low. Of course the greater part of the hospital is taken up by charity beds. Each has also an out-patient department. The assistants remain for a long time, as in the German hospitals, and receive a very thorough training.

I saw Dr. Coborubias, assistant to Dr. Sierra, do two difficult gall-bladder resections. The second case was as difficult a one as I have ever seen. Dr. Coborubias handled it in a masterful manner while his chief, Dr. Sierra, and I looked on.

Chilean surgical ideals are high. They are not surpassed by any country of South America. Hospital nursing, as we understand it, is poorly organized. Dr. Amunátegui believes, and I agree, that the solution of this problem is to send Chilean nurses to the United States for training. I under-

stand that this has already been brought about and that several Chilean girls are now in training at Wesley Hospital in Chicago.

In company with Dr. Amunátegui, its dean, I had an opportunity to visit the medical school and meet most of the heads of departments. I also inspected the excellent dental school in company with its able director, Dr. Jerman Valenzuela Basterrica. I may say that I was very well impressed with the scholarship and ideals of Chilean medical men.

In Valparaiso, I visited the Hospital of San Juan de Dios. I was especially interested in the laboratory department conducted by Dr. Koch. At the time of my visit, he was doing some interesting investigations in spectroscopic examinations of blood serum, seeking a changed refractive index in the serum of suspected syphilitics to check up on the Wassermann reaction. It was new to me and very interesting.

I also visited the German Hospital and saw the skillful Dr. Muenich do some interesting gastric surgery.

Before leaving Valparaiso, I was fêted at the famous Viña del Mar club and afterward taken to the last race meeting of the summer season. The beautiful grass track at Viña del Mar, with its encircling mountains, is famous throughout South America.

Lima, Peru

Leaving Valparaiso on the good ship "Ebro," I proceeded directly to Peru.

I had a pleasant and satisfactory session with our committee in Lima. Our meeting took the form of a luncheon in the restaurant of the Zoölogical Gardens, with a business session following. Dr. Juvenal Denegri presided. Among those present were: Dr. Guillermo Gastañeta, Dr. Francisco Graña, Dr. Miguel C. Aljovin and Dr. Carlos Morales. Dr. Carlos Vilaran, I learned, was abroad, and Dr. Constantino Carvallo, another member of the committee, had died during the past year. I saluted those present in the name of my North American confrères, and told them of our plans for next year. The Peruvian surgeons are enthusiastic about the American College of Surgeons, and the names of a number of new men were presented for approval. They were in hearty accord with next year's expedition and will be glad to welcome any of the men who decide to visit Lima.

Panama

My next and last official call was at Panama City, the capital of the Republic of Panama. The Panaman committee also has jurisdiction over the Canal Zone, which, properly speaking, is Panaman territory, although leased in perpetuity to the United States.

I was met by Dr. Runyan, the secretary of our committee, who took me to the Ancon Hospital and to the Herrick Clinic with which he is associated. Afterwards he conducted me to the conference which had been arranged at the Union Club.

As in Lima, they entertained me at luncheon and we had a good, warm session, following the luncheon. Those present were: Col. Louis T. Hess, Dr. Alfred B. Herrick, Dr. Troy W. Earhart, Dr. D. F. Rieder, Dr. Raymond W. Runyan, Dr. William C. Rucker, and Dr. E. I. Salisbury. Dr. Salisbury had just arrived from Venezuela the day before.

The situation in Panama is very good. There is not a large group, but including the government, the army and the navy, an exceptionally strong one. They are interested and enthusiastic for the College.

General Observations

The situation of the College in South America is excellent and a splendid start has been made.

South America is an immense continent. Distances are vast and countries are of tremendous expanse. In Brazil alone, consider the stupendous Amazonian forest. It staggers the imagination. The forest region is almost equal to the whole of Europe. Or the Cordillera so wonderfully described by Hudson: "That world-long stupendous chain, its sea of Titicaca and wintry, desolate Paramo, where lie the ruins of Tiahuanaca older than Thebes!"

As I said at the beginning of my report, this constitutes in the main the third chapter of a story of scientific and human inter-relationship, a story which is to go on into the future and to which I hope *finis* will never be written.

THE DEPARTMENT OF LITERARY RESEARCH AND THE COLLEGE LIBRARY

"A SUBSTANTIAL surgical library available to every Fellow" is the aim and immediate concern of the Department of Literary Research. The College Library must develop in such a way that it will be able to render complete service to members of the College and of the surgical profession of America wherever they may be located. It must be just as useful to those who are situated in the far West, the East, and the South as to those living in the middle West,—just as useful to members in Canada and in South America as to those in the United States.

To fulfill this purpose the Department of Literary Research was organized last September. It is doing for the Fellows of the College what the editorial or publication department of a large clinic does for the staff of that clinic. That it is meeting a real need is shown by the number and variety of requests which are constantly being received. During the past six months, a large number of research problems have been handled, many bibliographies have been prepared, and brief reviews of various subjects to form the bases of shorter papers have been made. In addition many single abstracts and translations have been prepared upon request, and inquiries as to references, translation of terms and the like have been answered. Practically every field in general surgery and the surgical specialties has been represented in these researches until there has now accumulated in the files of the Department a large amount of material dealing not only with the more important subjects in general surgery, but also with many problems in gynecology, obstetrics, genito-urinary surgery, orthopedic surgery, and the important specialties, ophthalmology, otology, and rhinology. In addition to the many purely scientific researches, data has also been collected to serve as the foundation for more popular addresses upon such subjects as "Cancer," "The Use of Radium," "The Building up of County Medical Societies," and "Choosing the Medical Profession." The Department has furnished material to surgeons in twenty-eight different states and to Fellows residing in Canada. It has also had opportunity to serve surgeons who are living in England and South America.

Every effort is made to carry on this service as economically as possible. The work is billed at slightly less than actual cost, the College bearing a certain percentage of the expense, and as the volume of the work increases, the cost to the individual will decrease, as there will be overlapping and duplication of requests. During the development of the College Library the Department has the use of the John Crerar Medical Library and, whenever necessary, calls upon the Surgeon General's collection and the New York Academy of Medicine.

To meet the many requests from those who desire only a little material on a subject and who do not care to have a special research made, package libraries on the more important subjects in general surgery and the surgical specialties are being developed. These will be composed of reprints, clippings, and the like and will be loaned free of charge for a period of two weeks. Progress is being made on these package libraries as rapidly as possible, and the Department hopes in time to have very comprehensive reference files which may be loaned in this manner. Reprints, clippings, unbound journals, and any data which would be of interest in the compiling of these files will be very gladly received.

The Department now has a staff of trained workers and is ready to fill promptly all requests received from Fellows of the College and members of the surgical profession of America. Surgeons wishing assistance in the preparation of papers for the fall meetings and in the collecting of material for longer monographs to be published during the coming year are urged to make their requests known at an early date, so that the Department may be able to do a portion of this work during the summer months and thus fill all requests at the desired time.

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Surgery, gynecology
& obstetrics

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